

AD A100348

LEVEL II

10

14 DRSAR/PE/R-89

6 VARIABLE COST TO PROCURE.

9 Final crypt.

10 NORMAN H. TRIER

RTIC
REF ID: A62016
JUN 17 1981

11 12 MAR 1981

12 87

Approved for public release; distribution unlimited.



81 6 16 145

US ARMY ARMAMENT MATERIEL READINESS COMMAND

PROGRAM ANALYSIS AND EVALUATION DIRECTORATE

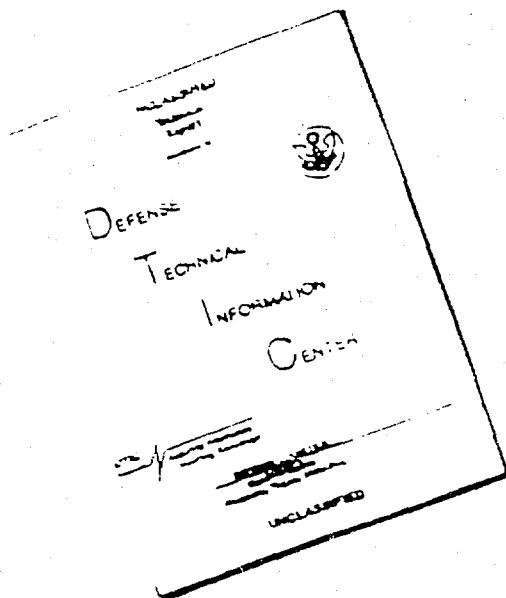
ROCK ISLAND, ILLINOIS 61299

* DMIC FILE COPY
* DMIC

100-112

MIX

DISCLAIMER NOTICE



**THIS DOCUMENT IS BEST
QUALITY AVAILABLE. THE COPY
FURNISHED TO DTIC CONTAINED
A SIGNIFICANT NUMBER OF
PAGES WHICH DO NOT
REPRODUCE LEGIBLY.**

DISPOSITION

Destroy this report when no longer needed. Do not return it to the originator.

DISCLAIMER

The findings in this report are not to be construed as an official Department of the Army position.

WARNING

Information and data contained in this document are based on input available at the time of preparation. Because the results may be subject to change, this document should not be construed to represent the official position of the US Army Materiel Development & Readiness Command unless so stated.

HQ AFMCOM CEMDC RI, IL	
CONTROL NO. 81-251 DATE 17 Mar 81	
VALIDATED ✓ BY MRAT	
NOT VALIDATED	
VALIDATION LEVEL	I <input checked="" type="radio"/> III
ANALYST <u>W. KALAL</u> PH. 719-3264	
VALID. EXPIRES 17 APR 81 SUPER. <u>D. K.</u>	

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DRSAR/PE/R-89	2. GOVT ACCESSION NO. AD-A100 348	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) VARIABLE COST TO PROCURE	5. TYPE OF REPORT & PERIOD COVERED Final Report	
7. AUTHOR(s) Norman H. Trier	6. PERFORMING ORG. REPORT NUMBER	
9. PERFORMING ORGANIZATION NAME AND ADDRESS US Army Armament Materiel Readiness Command Program Analysis and Evaluation Directorate Rock Island, IL 61299	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Armament Materiel Readiness Command Program Analysis and Evaluation Directorate Rock Island, IL 61299	12. REPORT DATE 12 March 1981	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	13. NUMBER OF PAGES 96	
16. DISTRIBUTION STATEMENT (of this Report) Approved for Public Release; Distribution Unlimited	18. SECURITY CLASS. (of this report) Unclassified	
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)	18a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)		
Inventory Control Cost to Procure Cost to Buy Cost to Order Army Stock Fund (ASF)	Procurement Work Directive (PWD) Cost Differential Economic Order Quantity Variable Safety Level Basic Ordering Agreements (BOA)	Procurement Army, Secondary (PAS) Procurement Request Order Number (PRON)
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)		
Variable Cost to Procure (VCP) parameters were developed for HQ, ARRCOM use in replenishment procurement of secondary items. The new VCP parameters are for orders having a Low Dollar Value (LDV) (less than \$10K each), High Dollar Value (HDV) (equal to or greater than \$10K each), and Basic Ordering Agreements (BOAs). The methodology is documented to minimize future procurement efforts at HQ, ARRCOM.		

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

SUMMARY

Variable Cost to Procure (VCP) parameters were developed for HQ, ARRCOM for use in procurement of secondary items, both Army Stock Fund (ASF) and PA Secondary (PAS) funded. The VCP is basically a procurement setup cost which is incurred each time ARRCOM initiates a request to replenish its stock of an individual secondary item. Included in the VCP parameters are direct and indirect labor, ADP, and support costs for (a) processing the purchase request (i.e. a Procurement Work Directive (PWD)) to procurement, (b) the purchase action, and (c) the receipt and payment. The new parameters will be entered in the Materiel Management Decision (MMD) file in the Commodity Command Standard System (CCSS) where they will be extracted as required for use in various study runs (i.e., the COST DIFFERENTIAL (COSDIF) computations and the Economic Order Quantity/ Variable Safety Level (EOQ/VSL) computations).

The approved cost breakout for the VCP parameters is for (1) Low Dollar Value (LDV) orders (less than \$10K), (2) High Dollar Value (HDV) orders (equal to or greater than \$10K), and (3) Basic Ordering Agreements (BOAs). The parameters currently used at HQ, ARRCOM are:

	LDV PWDs	HDV PWDs	BOAs
VCP for Stocked Item:	\$335	\$1,372	\$241
VCP for Non-Stocked Item:	\$275	\$ 819	\$198

The new parameters, as documented in this study, are as follows (in FY81 dollars):

	LDV PWDs	HDV PWDs	BOAs
VCP for Stocked Item:	\$704	\$2,023	\$415
VCP for Non-Stocked Item:	\$689	\$1,981	\$400

For the new parameters, the only difference between the stocked item and non-stocked item is that for a non-stocked item, the PWD is automatically generated when a requirement exists, and the initial item manager review of the Supply Control Study (SCS) is by-passed.

AR 710-1 states that the VCP parameters are to be updated when cost of living raises are granted or if the PWD process changes significantly. To accomplish this, a computer program was developed and documented, and data was gathered in such a manner as to minimize future effort at ARRCOM. The computer program takes such input as civilian and military salaries, number of PWDs processed in a given year, and yearly supply and communications costs. In addition, the input file for each directorate/office indicates each grade level of personnel and percent of time spent on processing secondary item PWDs, the number of slots at that grade level, and a ratio of effort to process a LDV PWD versus a HDV PWD. When input is changed, the program is executed and new VCP parameters are obtained.

TABLE OF CONTENTS

Summary	i
Table of Contents	ii
Objective	1
Application	1
Background	1
Approach	2
Methodology	5
Responsibilities of Directorates/Offices	6
Labor Costs	8
Automatic Data Processing (ADP) Costs	9
Support Costs	10
DCASR and Depot Receipt Costs	11
Total Variable Cost to Procure	12
VCP for Basic Ordering Agreements (BOAs)	13
Results	13
Appendix A: Sensitivity of VCP Parameters	A-1
Appendix B: List of Elements in VCP Parameters	B-1
Appendix C: VCP Computer Program Documentation	C-1
Appendix D: Analysis of PRONS	D-1
Appendix E: Data for Labor Costs	E-1
Appendix F: Data for ADP Costs	F-1
Appendix G: Data for Support Costs	G-1
Distribution	

Accommodation for	
NTIS Control	
DTIC Control	
Unpublished	
Justification	
By _____	
Distribution _____	
Availability Codes	
Dist	Avail and/or Special
A	

VARIABLE COST TO PROCURE

OBJECTIVE

- a. To determine for use at HQ, ARROOM a new set of variable cost to procure (VCP) parameters for procurement of secondary items, both Army Stock Fund (ASF) and PA Secondary (PAS) funded. The approved cost breakout for the VCP Parameters is for (1) Low Dollar Value (LDV) orders (less than \$10K), (2) High Dollar Value (HDV) orders (equal to or greater than \$10K), and (3) Basic Ordering Agreements (BOAs).
b. To document methodology so that the VCP parameters can be updated as required with a minimum amount of effort.

APPLICATION

The new cost to procure parameters would replace those parameters currently used in the COST DIFFERENTIAL (COSDIF) module and ECONOMIC ORDER QUANTITY/VARIABLE SAFETY LEVEL (EOQ/VSL) module in the Commodity Command Standard System (CCSS). The COSDIF and EOQ/VSL modules determine whether an item is stocked and when and how much of a secondary item should be purchased, respectively. The parameters would be entered permanently (until the next update study) in the Material Management Decision (MMD) file in CCSS, where they would be extracted as required.

BACKGROUND

The ordering cost parameters are basically procurement setup costs which are incurred each time ARROOM initiates a request (i.e. a Procurement Work Directive (PWD)) to replenish its stock of an individual item. The VCP is traded off with the estimated holding cost to determine the optimal time to buy that item. This trade off directly affects the frequency of replenishment procurement, i.e., the higher the ordering cost, the less frequently one tends to buy (and thus, a larger procurement quantity) and, conversely, the lower the ordering cost the more frequently one tends to buy (and thus, the smaller procurement quantity).

The VCP parameters are also used in the COSDIF WHAT TO STOCK MATHEMATICAL MODEL, where it's determined if items should be stocked or not. In general, if all other parameters remain constant, the number of items stocked would increase as the VCP parameters increase.

The VCP parameters currently used at HQ, ARRCOM^a are as follows:

	LDV PWDs	HDV PWDs	BQAs
VCP for Stocked Item:	\$335	\$1,372	\$241
VCP for Non-Stocked Item:	\$275	\$ 819	\$198

The importance of the VCP parameters as inputs to the EOQ/VSL cost equation should not be underestimated. Time should be spent to accurately estimate them annually at a minimum or whenever significant change occurs. Appendix A addresses the sensitivity of the total variable cost to the VCP parameters. It shows that within the domain of independent variables, if the VCP parameters were off by \$1.00, ARRCOM could save (i.e., use more wisely) \$572K per year by adjusting the VCP parameters. It is also reasonable to state that if ARRCOM's VCP parameters were off by \$10 (a 3% change (\$10/\$335) for LDV PWDs and a 1% change (\$10/\$1,372) for HDV PWDs), that ARRCOM could save (i.e., use more wisely) \$5.72M per year. It is not suggested that the results be used to quantify the total cost impact of large changes to VCP parameters because the assumptions of independence would no longer be valid (see Addendum 1 of Appendix A, page A-9).

APPROACH

In order to determine a new set of VCP parameters, information was gathered concerning direct and indirect labor, ADP, and support costs for (a) processing the purchase request (PWD) to procurement, (b) the purchase action, and (c) receipt and payment. Section II of Appendix B in AR 710-1 (C17) contains a list of functional elements to be included in the cost to procure. This list, shown in Appendix B of this report, served as a basis for obtaining data from various directorates which process secondary item PWDs. Data was gathered for each specific element unless it was feasible to gather data for a group of elements. For example, the procurement directorate is already conveniently divided into areas which process LDV secondary item PWDs, and areas processing HDV PWDs; therefore a combined price could easily be obtained.

When determining the VCP parameters, data should reflect the variable costs related to the frequency of replenishment actions, and care should be taken to exclude fixed costs. As per AR 710-1, fixed costs are those that are judged to remain constant if 50% of the workload were eliminated. This evaluation can be difficult at times. Consider, for example, whether supervisor's time should be included in the VCP parameters. If the secondary item workload is reduced by 50%, working personnel would probably be reduced, but it's questionable whether sections or branches of offices would be combined, thereby eliminating some supervisor's positions. Many other factors would

^a Those parameters were developed by HQ, TARCOM and documented in the report titled TARCOM Cost to Buy, DRSTA-EC, Feb 78.

probably enter the decision. One must address these situations and just try to be consistent. For this study, if the majority of workload in a division, branch, or section is identified as processing secondary item PWDs, a percent of the supervisors time was included commensurate to the percent of his employee's time processing secondary item PWDs.

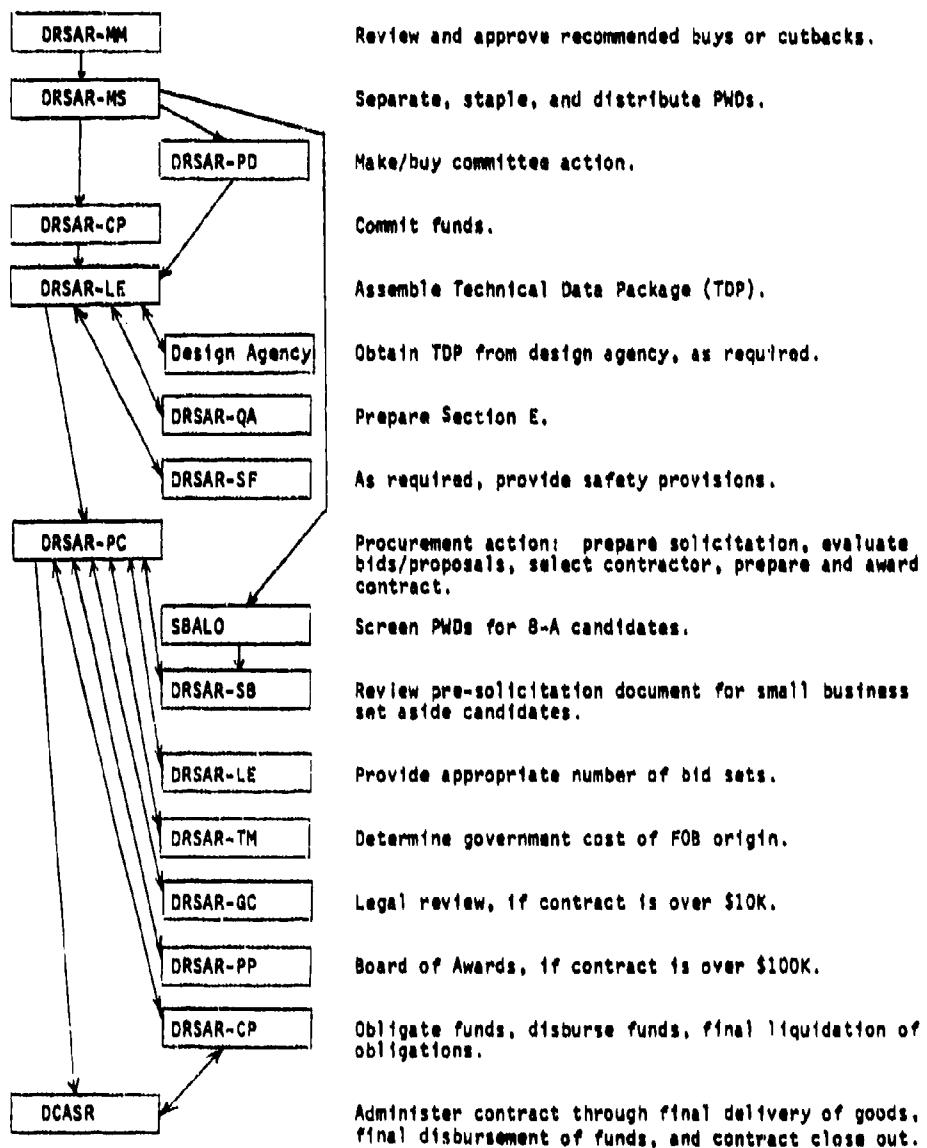
In order to understand the secondary item procurement process, a simplified overview is shown in Table 1. The office symbols are:

DRSAR-MM	Materiel Management Directorate
DRSAR-MS	Management Information Systems Directorate
DRSAR-PD	Production Directorate
DRSAR-CP	Office of the Comptroller
DRSAR-LE	Logistics Engineering Directorate
DRSAR-QA	Product Assurance Directorate
DRSAR-SF	Safety Office
DRSAR-PC	Procurement Directorate
DRSAR-TM	Transportation Directorate
DRSAR-SB	Small Business Office
DRSAR-GC	Office of Chief Counsel and Congressional Affairs
DRSAR-PP	Procurement and Production Policy and Plans Office
SBALO	Small Business Administration Liaison Office
DCASR	Defense Contract Administration Services Region

The VCP parameters are average costs to process secondary item PWDs for replenishment procurement. To determine the VCP parameters, the total costs for a year for processing secondary item LDV PWDs and for HDV PWDs are established. Those total costs are then divided by their respective populations. It should be understood that during any given 12 month period, the PWDs actually processed are a composite of several fiscal year (FY) programs (i.e. FY80, FY79, FY78, etc.). It is therefore assumed that the cost of processing a specific fiscal year program (e.g. FY80) through subsequent years to completion is essentially equal to the cost of processing the composite of all fiscal year programs during a 12 month period (e.g. 1 Oct 79 to 30 Sep 80).

The total costs include direct and indirect labor, ADP, materiels and supplies, equipment rental, communication services, and postage. All these costs are obtained from the directorates involved in processing secondary item PWDs. The number of PWDs generated is obtained from the Materiel Acquisition and Delivery (MAD) File in CCSS. Details are discussed in the following section.

Table 1
PROCUREMENT PROCESS FOR SECONDARY ITEMS: SIMPLIFIED OVERVIEW



METHODOLOGY

In general, for each dollar category (LDV and HDV) the total HQ, ARRCOM labor plus fringe benefits, ADP, materials and supplies expended in processing secondary item PWDs for a year period are identified. These total costs are divided by the total number of PWDs generated in a year period for each dollar category to obtain the VCP parameters. This assures that the VCP parameters reflect average costs per PWD, and avoids problem areas where different directorates process different number of PWDs, and therefore, have an unequal base.

Tables of Distribution Authorization (TDAs) for each of ARRCOM's directorates/offices were obtained. For each TDA line number the percent of time for processing secondary item PWDs and the ratio of that effort spent on LDV PWDs versus HDV PWDs are determined. This is then multiplied by the appropriate general schedule salary (using Step 5 for all cases) or military salary^a yielding a yearly labor cost for processing secondary item LDV and HDV PWDs. Dividing the yearly labor cost by the number of PWDs processed in the two categories, yields the labor cost per PWD. The total labor cost per PWD for each category is increased by 29% for fringe benefits^b. Finally the labor cost for DCASR personnel, plus the cost of ADP, materials and supplies, equipment rental, and other support costs are added on, yielding the total VCP parameters.

To perform the above computations, a small computer program was written, and is documented in Appendix C. Data for each TDA line number, which is considered part of the PWD process, is stored in a file for each directorate. A file for the GS salaries (Step 5), Military Salaries, etc. is also maintained, along with other appropriate data (see Appendix C for details), allowing the VCP parameters to be easily updated. For example, when cost of living raises are granted, the file containing salaries is updated and the computer program re-run to obtain new cost to procure parameters. Or, if significant changes occur in the processing of secondary item PWDs, then the associated directorate files only need changing and the computer program re-run to obtain new VCP parameters.

Not yet discussed, but certainly important, is the determination of the number of secondary item LDV and HDV PWDs which were processed through ARRCOM in a year period. For this study data was extracted from the Material Acquisition and Delivery Issued (MADISS) File, Sector 00, Segment 201 for all PWDs issued during FY80. This file contains all issued PWDs, whether they be for secondary items (both ASF and PA secondary (PAS funded)), principal end items, or ammunition. The principal data elements used are the PRON number and amendment number,

^aDF, DRSAR-CP, 20 Nov 80, subject: Composite Standard Rates for Costing Military Personnel Services -FY81.

^bAs per guidance in C17, AR 710-1, 1 April 80.

date ordered, delete code, financial inventory accounting code, and the total order amount. With these data elements, the number of PWDs issued for different funding categories and their distribution with respect to dollar value per PWD are easily obtained (see details in Appendix D). For FY80, the number of LDV secondary item PWDs (basic PRONs) equalled 5,323 while the number of HDV PWDs equalled 2,122 (see Appendix D, Table D-10, pg D-13). These numbers exclude provisioning PWDs since the VCP parameters are only used with replenishment actions. Also excluded are the numbers of cancelled replenishment PWDs since the VCP parameters are based on the number of replenishment PWDs which are processed through receipt and payment for goods; however, the labor, up to and including the cancellation action, is included in the total cost to process replenishment PWDs. Another source to get similar data on the number of PWDs is from the DRSAR-PC PWD Workload Report; however, it is not possible to determine the quantity of provisioning PWDs.

RESPONSIBILITIES OF DIRECTORATES/OFFICES

This section contains a brief summary of the major tasks performed by each directorate/office that are related to the processing of secondary item PWDs.

1. MATERIEL MANAGEMENT DIRECTORATE

- a. Review and approve/disapprove supply control studies (SCS) which have recommended buys and cutbacks.
- b. Resolve problems with items which are in the procurement cycle.
- c. Forecast buys for procurement planning.
- d. Process receipt of shipment forms from depots.
- e. Process all changes (amendments) to PWDs.

2. OFFICE OF THE COMPTROLLER

- a. Certify funds, both for ASF items and PA secondary (PAS) items.
- b. Obligate funds when the items are put on contract.
- c. Direct the disbursement of funds.

3. LOGISTICS ENGINEERING DIRECTORATE

- a. Assembly Technical Data Package (TDP).
- b. Provide required number of bid sets to procurement.

4. PROCUREMENT DIRECTORATE

- a. Prepare solicitation.
- b. Evaluate bids/proposals.
- c. Select contractor.
- d. Prepare and award contract.

5. PRODUCTION DIRECTORATE: Make/buy committee action

6. MANAGEMENT INFORMATION SYSTEMS DIRECTORATE

- a. Run CCSS applications.
- b. Separate printouts and distribute.

7. PRODUCT ASSURANCE DIRECTORATE

- a. Provide Section E of PRONs, i.e. (1) level of inspection
- (2) First Article Test (FAT) requirements, (3) First Article Inspection Test Equipment (FAITE) availability, and GFM/GFE.
- b. QA support to contracts, i.e. technical assistance to Procurement and Production.

8. SAFETY OFFICE: Review Procurement Package Input Requests, DRSAR Form 337 and 197 to determine if safety provisions are required.

9. TRANSPORTATION DIRECTORATE: Determine government cost of transportation for FOB origin.

10. SMALL BUSINESS OFFICE: Review pre-solicitation documents for small business set aside candidates.

11. SMALL BUSINESS ADMINISTRATION LIAISON OFFICE: Screen all PWDs for 8-A candidates (minority businesses).

12. OFFICE OF CHIEF COUNCIL AND CONGRESSIONAL AFFAIRS

- a. Legal review of all contracts valued over \$10K.
- b. Legal guidance/participation in default actions or purchase order withdrawals.
- c. Respond to Congressional inquiries on specific contracts.

13. P & P POLICY AND PLANS OFFICE

- a. Chair Board of Awards Committee.
- b. Resolve problems with items in the procurement cycle.
- c. Implement the Procurement Aging and Staging System (PASS).

LABOR COSTS

A summary of the labor costs applicable to the VCP parameters is shown in Table 2. These costs are based on the data listed in Appendix E, which was input to the computer program (documented in Appendix C). Data in Table 2 was extracted from the program output as shown in Section C-4 of Appendix C. The labor costs include both direct and indirect labor. All costs shown are in FY81 dollars.

Table 2. LABOR COST PER PWD

	<u>LDV PWDs</u>	<u>HDV PWDs</u>
Materiel Management Directorate	\$113	\$322
Office of the Comptroller	46	46
Logistics Engineering Directorate	46	46
Procurement Directorate	157	757
Production Directorate	3	3
Management Information Systems Directorate	-	-
Product Assurance Directorate	57	57
Safety Office	-	-
Transportation Directorate	1	1
Small Business Office	1	6
Small Business Association		
Liaison Office	-	4
Office of Chief Council	-	14
P&P Policy and Plans Office	22	23
 TOTAL	 \$448/PWD ^a	 \$1,281/PWD ^a

The labor cost for the Defense Contract Administration Services Region (DCASR) are not included in Table 2, but will be discussed later in a separate section.

As per guidance from AR 710-1 (see Appendix B, Section II, Part III) labor fringe benefits costs totalling 29% of the labor costs are to be included in the VCP parameters. The 29% is composed of (a) 8% for personnel benefits such as health insurance, retirement, life insurance and disability, and (b) 21% for leave entitlements to cover sick leave and annual leave, holiday leave, and administrative leave. The labor fringe benefits are as follows:

	<u>LDV PWDs</u>	<u>HDV PWDs</u>
Labor costs	\$448/PWD	\$1,281/PWD
Labor benefits factor	<u>29%</u>	<u>29%</u>
 Labor fringe benefits	 \$130/PWD ^a	 \$ 372/PWD ^a

^aDue to rounding, the total value may be slightly different from the sum (or product) of the above numbers. Actual numbers are shown in Appendix C, page C-11.

AUTOMATIC DATA PROCESSING (ADP) COSTS

This section contains a summary of the CCSS applications which totally/partially contribute to the cost to procure. Even though most of these applications are run periodically, the Central Processing Unit (CPU) time is considered part of the VCP parameters since the length of the run depends on the number of PWDs. The applicable applications along with their associated cost per PWD are shown in Table 3. Appendix F contains a description of each application as well as the determination of applied percentages to the VCP parameters.

Table 3. SUMMARY OF ADP COSTS

<u>Application Number</u>	<u>Title</u>	<u>Cost/Year (FY81 \$)</u>
#404	Requirements Control Process	\$14,750
#405	CCSS Milscap/Interface	15,835
#406	Financial Fiscal	7,139
#418	Pre-Supply Control Study Update	1,235
#420	Supply Control Study Review & Computation	1,918
#421	Supply Control Study Format & Print	10,385
#471	Standard Automated Bidders List (SABL)	9,340
#511	Procurement Aging & Staging System (PASS)	1,578
#518	Work Ordering & Reporting Communications System (WORCS)	1,249
#521	Control Input Data Entry System (COIN)	--
#532	Requirements Determination & Execution System	9,602
#542	ARTIS	--
#558	EOQ/VSL Simulation	--
TOTAL APPLICATIONS COST PER YEAR		\$73,031

$$\text{ADP Cost/PWD} = \$73,031 / 7,445^a = \$9.81/\text{PWD}$$

^aThe number of PWDs initiated during FY80 at HQ, ARRCOM is extracted from Appendix D, Table D-10 (page D-13).

SUPPORT COSTS

This section contains a summary of the support costs which are determined to be part of the VCP parameters. Appendix G contains the explanations as to how these figures were derived.

	COST PER PWD	
	<u>LDV</u>	<u>HDV</u>
a. Materials and supplies: considered costs from the Procurement Directorate for preparing solicitations and contracts, and from the Logistics Engineering Directorate for the reproduction of bid sets.	\$ 6.	\$10.
b. Long distance telephone calls: considered costs from the Procurement Directorate for their discussions with contractors.	-	-
c. Mail: considered costs from the Procurement Directorate for mailing of purchase requests, solicitations, contracts, etc.	\$8.	\$8.
d. Personnel Support: considered a percent of the Civilian Personnel Office (CPO). The percent was determined by dividing the equivalent ^b number of people involved in processing secondary item PWDs, by the total workforce supported by CPO.	\$8.	\$20.
TOTAL SUPPORT COST PER PWD	\$23./PWD ^a	\$38./PWD ^a

^a Due to rounding, the total value may be slightly different from the sum of the above numbers. Actual numbers are shown in Appendix C, page C-11, or Appendix G.

^b One equivalent person equals 2,080 hours of labor. Refer to Appendix G for an example.

DCASR and DEPOT RECEIPTS COSTS

The costs for the Defense Contract Administration Services Region and the depot receipt are obtained from the Feb 78 TARCOM Cost to Buy Study^a. The TARCOM study noted that the DCASR costs were FY75^b costs which they escalated to FY78. DARCOM, DRCM-RS acknowledged that more recent data was not available. Therefore, the FY75 costs were further escalated to FY81 by applying the cost of living increases to the general schedule salaries as was done in the JAN 81 TACOM COST TO BUY study^c.

	LDV PWDs	HDV PWDs
Depot Receipt (FY78 dollars)	\$ 5.00/PWD	\$ 5.00/PWD
DCAS cost (FY78 dollars)	\$71.15/PWD	\$256.75/PWD
	\$76.15/PWD	\$261.75/PWD
OCT 78 Cost of living increase (5.5 percent)	\$ 4.19/PWD	\$ 14.40/PWD
OCT 79 Cost of living increase (7.0 percent)	\$ 5.62/PWD	\$ 19.33/PWD
OCT 80 Cost of living increase (9.1 percent)	\$ 7.82/PWD	\$ 26.89/PWD
DCASR and Depot Receipt Cost (FY81 Dollars)	\$93.78/PWD	\$322.37/PWD

a TARCOM Cost to Buy, Report Number ECC-10-6-04, DRSTA-EC, FEB 78.

b Message, AMCU-KE, HQ, AMC, 101955Z Jun 75, subject: Revised Variable Ordering Costs.

c TACOM COST TO BUY FY81 UPDATE, Report number ECC-10-80-09,
Systems and Cost Analysis Directorate, JAN 81.

TOTAL VARIABLE COST TO PROCURE

The following is a summary of the variable cost to procure parameters (in FY81 Dollars):

	<u>LDV PWDs</u>	<u>HDV PWDs</u>
Labor	\$448	\$1,281
Labor Benefits	130	372
ADP	10	10
Support	23	38
DCASR	<u>94</u>	<u>322</u>
TOTAL VARIABLE COST TO PROCURE:	\$704/PWD^a	\$2,023/PWD^b

At HQ, ARRCOM, the VCP for a LDV PWD equals \$704 and the cost for a HDV PWD equals \$2,023. The above values are for stocked secondary item PWDS (both ASF and PAS funded). The new parameters for non-stocked secondary items are slightly lower; the only difference in processing the PWDs is that a PWD is automatically generated when a requirement exists for non-stocked items. For a stocked item a SCS is first generated indicating a recommended buy and the item manager must first approve it before a PWD is generated. This initial review of SCS is estimated at 10% of the cost per PWD for labor and benefits in the Materiel Management Directorate. The VCP parameters for non-stocked items are:

	<u>LDV PWD</u>	<u>HDV PWD</u>
VCP for Stocked Items	\$704/PWD	\$2,023/PWD
Reduction for initial review (labor and benefits)	<u>\$ 15/PWD^b</u>	<u>\$ 42/PWD^c</u>
VCP for Non-Stocked Items	\$689/PWD	\$1,981/PWD

^a Due to rounding, the total value may be slightly different from the sum of the above numbers. Actual numbers are shown in Appendix C, page C-11.

^b Determined as 10% * \$113 * 1.29 = \$14.58 (rounded to \$15)

^c Determined as 10% * \$322 * 1.29 = \$41.54 (rounded to \$42)

VCP FOR BASIC ORDERING AGREEMENTS

Basic Ordering Agreements (BOAs) are special types of contracts which are negotiated periodically (usually annually) for varying amounts of National Stock Numbers (NSNs). Then when a NSN reaches its reorder point, a delivery order is generated against the BOA, and the contractor produces and delivers the goods.

The contract negotiations are performed periodically whether an item is at its reorder point or not, and hence are not considered part of the variable cost to procure parameters. However, all actions which are performed as a result of a delivery order are considered part of the variable cost to procure for BOAs.

At HQ, ARRCOM relatively few (less than 25) BOAs are used for replenishment of secondary items, so it was difficult to obtain specific data on processing delivery orders for BOAs.

Table 4 shows the costs which were included in the Variable Cost to Procure for BOAs. The VCP for delivery orders of stocked secondary items equals \$415. As discussed in the previous section (pg 12), the VCP for non-stocked items can be reduced by \$15 due to the elimination of the initial item manager review of the SCS. The VCP for delivery orders of non-stocked secondary items is (\$415 - 15) or \$400.

RESULTS

This report documented the VCP parameters developed at HQ, ARRCOM for use in replenishment procurement of secondary items. The approved cost breakout is for (1) Low Dollar Value (LDV) orders (less than \$10K), (2) High Dollar Values (HDV) orders (equal to or greater than \$10K), and (3) Basic Ordering Agreements (BOAs). The new parameters, as documented herein, are (in FY81 dollars):

	LDV PWDs	HDV PWDs	BOAs
VCP for Stocked Item	\$704	\$2,023	\$415
VCP for Non-Stocked Item	\$689	\$1,981	\$400

AR710-1 states that the VCP parameters are to be updated when the cost of living raises are granted or if the PWD process changes significantly. To accomplish this, a computer program was developed and documented in Appendix C, and data was gathered in such a manner as to minimize future effort at ARRCOM.

Table 4. VCP FOR BOAs

	<u>Cost per PWD^a</u>
DRSAR-MM ^b (50% of value shown on page 8)	\$ 57.
DRSAR-CP (as shown on page 8)	46.
DRSAR-PC (as shown on page 8)	<u>157.</u>
TOTAL LABOR	\$260.
Labor Benefits (at 29% of the above total labor)	\$ 75.
ADP (as shown on page 9)	\$ 10.
Support Costs (as shown on page 10)	\$ 23.
DCASR ^c (50 % of value shown on page 11)	<u>\$ 47.</u>
VCP for BOAs	\$415.

a Since the delivery order is more like a purchase order, the regular cost per PWD for LDV PWDS will be used for all delivery orders.

b The cost per PWD for DRSAR-MM is assumed to be 50 percent of their regular cost due to reduced time for answering questions which arise on PWDS, etc.

c Only a portion of the DCASR cost should be used, i.e., that portion which is for the production follow up. It is estimated that 50 percent of the cost should be applied.

Appendix A

SENSITIVITY OF VCP PARAMETERS

DRSAR-PES

MEMORANDUM FOR RECORD

2 JUN 1981

SUBJECT: Variable Ordering Cost Parameters

1. As stated in AR 710-1, Centralized Inventory Management of the Army Supply System, Dec 70, C17, paragraph 2-11(5), the variable ordering cost parameters are to be reviewed and updated by each commodity command as a minimum annually or whenever a significant change occurs. Any increase in labor costs should be used to update that portion of the variable ordering costs.
2. HQ, ARRCOM currently uses variable cost to order parameters which were developed by HQ, TARCOM during FY78. Those parameters have not been reviewed or updated since that time. Per referenced guidance (paragraph 1), these parameters must be reviewed and updated. The question then arises as to how much effort is justified in performing the review and analysis, particularly the first time at HQ, ARRCOM since this function has never been performed here. To answer this question, the sensitivity of the total cost with respect to the ordering cost is addressed in this MFR.
3. The ordering cost is basically a procurement set-up cost which is incurred each time ARRCOM initiates a request to replenish its stock of an individual item. The ordering cost is traded-off with the estimated holding cost in the EOQ/VSL cost equation to determine the optimal time to buy that item. This trade-off directly affects the frequency of replenishment procurements, i.e., the higher the ordering cost, the less frequently one tends to buy (and thus, a larger procurement quantity) and, conversely, the lower the ordering cost the more frequently one tends to buy (and thus, a smaller procurement quantity).
4. The total variable cost model used by the Army is found in AR 710-1, Figure 4-6. In this model the stockout penalty depends on the duration of stockout, and the holding cost is applied to the inventory position. A similar model is found in the Naval Research Logistics Quarterly, V17(12) Jun 70, in an article by Presutti and Trepp titled, "More Ado About Economic Order Quantities (EOQ)". That model is found below and is used as a basis of this memorandum since it is more amenable for further manipulation.

Total Variable Cost (TVC) Equation (\$/Year)

$$EQ\ 1 \quad TVC = \sum_{i=1}^n \frac{A_i D_i}{Q_i} + \sum_{i=1}^n a_i c_i (\mu_i + K_i \sigma_i + \frac{Q_i}{2})$$

Subject to the following constraint

$$\sum_{i=1}^n \frac{0.5 Z_i \sigma_i^2}{2 Q_i} \left[1 - \exp(-\sqrt{2} \frac{Q_i}{\sigma_i}) \right] \exp(-\sqrt{2} K_i) \leq \beta$$

$$\text{In most cases, } \left[1 - \exp(-\sqrt{2} \frac{Q_i}{\sigma_i}) \right] \approx 1$$

Therefore, the constraint becomes

$$EQ\ 2 \quad \sum_{i=1}^n \frac{0.5 Z_i \sigma_i^2}{2 Q_i} \exp(-\sqrt{2} K_i) \leq \beta$$

where: Q = order quantity (units)

D = annual demands (units)

K = safety factor

σ = std. deviation of unit demand during a lead time

a = holding cost factor

A = ordering cost (dollars per order)

c = item cost (dollars per unit)

μ = mean lead time demands

Z = item essentiality (relative military worth)

β = constraint - expected number of essentiality-weighted units in a backordered position at any point in time.

n = number of different items in the inventory

12 JUN 1961

In order to determine the change in the Total Variable Cost (TVC) as the ordering cost (A) changes, the derivative of TVC with respect to A is needed. To do this the following theorem is used:

Theorem^a. If $f(u, v)$ is a differentiable function of u , v , and u , v are differentiable functions of x , y , the composite functions, $f(u(x,y), v(x,y)) = F(x,y)$,

is a differentiable function of x, y , whose partial derivatives are given by

$$\frac{\partial f}{\partial x} = \frac{\partial f}{\partial u} \frac{\partial u}{\partial x} + \frac{\partial f}{\partial v} \frac{\partial v}{\partial x},$$

$$\frac{\partial f}{\partial y} = \frac{\partial f}{\partial u} \frac{\partial u}{\partial y} + \frac{\partial f}{\partial v} \frac{\partial v}{\partial y},$$

and whose total differential,

$$df = \frac{\partial f}{\partial u} du + \frac{\partial f}{\partial v} dv,$$

has the same form as if u, v were independent variables.

The TVC equation is a differentiable function of $\{A, Q, D, a, c, \mu, K, \sigma, Z, \beta\}$, some of which are relatively independent and some of which are dependent. The TVC function can be written as follows (see Addendum 1 for explanations why some variables are considered independent while others are considered dependent):

$$EQ 3 \text{ TVC} = f\{A(Q, c), Q(A, a, D, \sigma, c), D, a, c, \mu(D), K(D, \sigma), \sigma(D), Z, \beta(K, \sigma, Q)\}$$

Now, by applying the stated theorem

$$EQ 4 \text{ dTVC} = \frac{\partial f}{\partial A} dA + \frac{\partial f}{\partial Q} dQ + \frac{\partial f}{\partial D} dD + \frac{\partial f}{\partial a} da + \frac{\partial f}{\partial c} dc + \frac{\partial f}{\partial \mu} d\mu + \frac{\partial f}{\partial K} dK +$$
$$\frac{\partial f}{\partial \sigma} d\sigma + \frac{\partial f}{\partial Z} dZ + \frac{\partial f}{\partial \beta} d\beta$$

^aBrand, Louis, Advanced Calculus, pg 157, John Wiley and Sons, Inc., New York, 1955.

12 JUN 1980

To solve this, the derivative of each variable is required. Since the variables D, a, c, and Z are independent parameters which are treated as constants (see Addendum 1 for explanation), their derivatives equal zero. That is:

$$dD = 0$$

$$da = 0$$

$$dc = 0$$

$$dZ = 0$$

By applying the stated theorem, the derivatives of the remaining variables are determined:

$$d\mu = \frac{\partial \mu}{\partial D} dD = \frac{\partial \mu}{\partial D} (0) = 0$$

$$d\sigma = \frac{\partial \sigma}{\partial D} dD = 0$$

$$dK = \frac{\partial K}{\partial D} dD + \frac{\partial K}{\partial \sigma} d\sigma = 0$$

$$dQ = \frac{\partial Q}{\partial A} dA + \frac{\partial Q}{\partial a} da + \frac{\partial Q}{\partial D} dD + \frac{\partial Q}{\partial \sigma} d\sigma + \frac{\partial Q}{\partial c} dc$$

$$dQ = \frac{\partial Q}{\partial A} dA$$

$$d\beta = \frac{\partial \beta}{\partial K} dK + \frac{\partial \beta}{\partial \sigma} d\sigma + \frac{\partial \beta}{\partial Q} dQ$$

$$d\beta = \frac{\partial \beta}{\partial Q} dQ = \frac{\partial \beta}{\partial Q} \frac{\partial Q}{\partial A} dA$$

Substituting these values into Equation 4 yields:

$$\begin{aligned} dTVC &= \frac{\partial f}{\partial A} dA + \frac{\partial f}{\partial Q} \left[\frac{\partial Q}{\partial A} dA \right] + \frac{\partial f}{\partial D} (0) + \frac{\partial f}{\partial a} (0) + \frac{\partial f}{\partial c} (0) + \\ &\quad \frac{\partial f}{\partial \mu} (0) + \frac{\partial f}{\partial K} (0) + \frac{\partial f}{\partial \sigma} (0) + \frac{\partial f}{\partial Z} (0) + \frac{\partial f}{\partial \beta} \left[\frac{\partial \beta}{\partial Q} \frac{\partial Q}{\partial A} dA \right] \end{aligned}$$

2 JUN 1980

which reduces to:

$$EQ\ 5 \quad dTVC = \frac{\partial f}{\partial A} dA + \frac{\partial f}{\partial Q} \frac{\partial Q}{\partial A} dA + \frac{\partial f}{\partial \beta} \frac{\partial \beta}{\partial Q} \frac{\partial Q}{\partial A} dA$$

This equation can be further reduced by recognizing that the partial derivative of the TVC with respect to β ($\frac{\partial f}{\partial \beta}$) equals zero, and hence the last term is eliminated.

The equation can now be written as follows:

$$EQ\ 6 \quad dTVC = \left[\frac{\partial f}{\partial A} + \frac{\partial f}{\partial Q} \frac{\partial Q}{\partial A} \right] dA$$

or

$$EQ\ 7 \quad \frac{dTVC}{dA} = \frac{\partial f}{\partial A} + \frac{\partial f}{\partial Q} \frac{\partial Q}{\partial A}$$

To solve EQ 7, the three partial derivatives must be determined. The equation for Q_1 was found through the application of the Lagrange Function using EQ 1 and EQ 2 (see Addendum 2 for details).

$$Q_1 = \frac{\sigma_1}{\sqrt{2}} \pm \sqrt{\frac{2A_1 D_1}{a_1 c_1} + \left(\frac{\sigma_1}{\sqrt{2}} \right)^2}$$

The partial derivative of Q_1 with respect to A_1 is then determined (see Addendum 3 for details):

$$\frac{\partial Q_1}{\partial A_1} = \frac{D_1}{a_1 c_1 \left(Q_1 - \frac{\sigma_1}{\sqrt{2}} \right)}$$

Note that the partial derivative of Q_1 with respect to A_1 is evaluated at the optimal value of Q_1 .

The partial derivative of the TVC function with respect to A_i and Q_i are:

$$\frac{\partial f_i}{\partial A_i} = \frac{D_i}{Q_i}$$

$$\frac{\partial f_i}{\partial Q_i} = \frac{-A_i D_i}{Q_i^2} + \frac{a_i c_i}{2}$$

These values can now be substituted into EQ 7.

$$\frac{d\text{TVC}}{dA} = \sum_{i=1}^n \left\{ \frac{D_i}{Q_i} + \left[\frac{-A_i D_i}{Q_i^2} + \frac{a_i c_i}{2} \right] \cdot \left[\frac{D_i}{a_i c_i \left(Q_i - \frac{\sigma_i}{\sqrt{2}} \right)} \right] \right\}$$

$$\text{EQ 8 } \frac{d\text{TVC}}{dA} = \sum_{i=1}^n \left[\frac{D_i}{Q_i} - \frac{A_i D_i^2}{a_i c_i Q_i^2 \left(Q_i - \frac{\sigma_i}{\sqrt{2}} \right)} + \frac{D_i}{2 \left(Q_i - \frac{\sigma_i}{\sqrt{2}} \right)} \right]$$

To make EQ 8 more amenable to rough calculations, it is assumed that $\sigma_i \rightarrow 0$.

$$\frac{d\text{TVC}}{dA} = \sum_{i=1}^n \left[\frac{D_i}{Q_i} - \frac{A_i D_i^2}{a_i c_i Q_i^3} + \frac{D_i}{2Q_i} \right]$$

$$\text{EQ 9 } \frac{d\text{TVC}}{dA} = \sum_{i=1}^n \left[\left(\frac{3}{2} \right) \left(\frac{D_i}{Q_i} \right) - \frac{A_i}{a_i (c_i Q_i)} \left(\frac{D_i}{Q_i} \right)^2 \right]$$

82 JUN 1980

In order to solve EQ 9, the unit price (UPRICE), the reorder cycle months (REOCY-MOS), and the reorder cycle quantity (REOCY-QTY) were extracted from the NSNMDR for each ARRCOM stocked secondary item (both ASF and PAS funded). With these values, EQ 9 can be solved, since:

$$D_i/Q_i = 1.20/REOCY-MOS$$

$$c_i \cdot Q_i = UPRICE \cdot REOCY-QTY$$

$$a_i = 0.23$$

$$A_i = \begin{cases} \$1372.00 & \text{when } (c_i \cdot Q_i) \geq \$10K \\ \$335.00 & \text{when } (c_i \cdot Q_i) < \$10K \end{cases}$$

Several characteristics of the data used in this analysis are presented in order to provide a better understanding of the items under consideration.

value of reorder quantity ($c_i \cdot Q_i$)	$\geq \$10K$	$< \$10K$
number of stocked items (N)	1,164	18,152
average value of $c_i \cdot Q_i$	\$67,528.38	\$1,653.65
average frequency of replenishment actions (D_i/Q_i)	1.42/year	0.55/year

Through the application of the program in Addendum 4 to the data from the NSNMDR, EQ 9 was solved, yielding:

$$\frac{dTVC}{dA} = \frac{-\$572,216.77}{\$1.00}$$

That is, if the variable cost to order were off by \$1.00, ARRCOM could save (i.e., use more wisely) \$572K per year by adjusting the VCO parameters (which, in turn, adjust the EOQ, etc.). One should note that this solution is only valid for small changes within the domain of the independent variables.

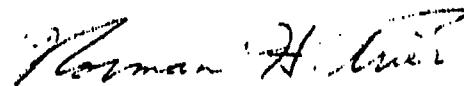
It is reasonable to state, however, that if ARRCOM's VCO parameters were off by \$10 (a 3% change for values less than \$10K, and a 1% change for values $\geq \$10K$), then ARRCOM could save (use more wisely) \$5.72M per year by adjusting the VCO parameters. It is not suggested that the results be used to quantify the total cost impact of large changes to VCO parameters because the assumptions of the independence of several other parameters would no longer be valid (see Addendum 1).

12 JUN 198

This analysis did assume that each item's standard deviation of unit demand during lead time (σ_1) approached zero, which, if included in the estimation, would have some impact on the final answer; however, for the purpose of this memo, that added accuracy is not deemed necessary.

This analysis does show that the VCO parameters are important factors used in the calculation of the VSL/EOQ for items in inventory by the Army. It is my opinion that ARRCOM's VCO parameters should be updated and that a 2 to 3 month study would certainly be justified.

The undersigned wishes to express appreciation to Mr. Fred Northey, DRSAR-PES, who again provided sound technical guidance, both theoretical and applications, throughout the course of the memorandum.



NORMAN H. TRIER
Operations Research Analyst
Systems Assessment Division
Program Analysis and
Evaluation Directorate

CF:
DIRECTOR, DRSAR-PE
Bill Funai, DRSAR-MMP
Fred Northey, DRSAR-PES

ADDENDUM 1

This addendum provides the explanation for determining whether a variable in the total cost equation is either independent or dependent.

$f(D)$: D is an independent variable. The demands from the field are generated due to parts failing or preventive maintenance and do not depend on any other parameters in the TVC equation.

$f(a)$: a is an independent variable. The holding cost factor is currently set at 23% and does not vary even if the other parameters change (unless very large changes are implemented).

$f(c)$: c is an independent variable. The item cost will not change when considering small changes in the order quantity. Certainly if large changes were considered, then quantity discounts could become available and the item cost could change; however, for application in this memo-random, the item cost does not change.

$f(Z)$: Z is an independent variable. The item's essentiality does not depend on any other variables, and besides, it is currently not used.

$f(\mu(D))$: μ depends of D. The mean lead time demands is the product of the item's lead time (PROLT (in years)) and the item's annual demand (D). Since only small changes in ordering costs are considered, the lead time will remain approximately constant.

$f(\sigma(D))$: σ depends on D. Each item's annual demand has some value for the standard deviation, both of which do not depend on any other parameters in the TVC equation.

$f(K(D,\sigma))$: K depends on D and σ . The safety factor can have values of 0, 1, 2, or 3, which can be applied to each item's standard deviation (σ) of its annual demand (D). It, too, does not depend on any other variable in the TVC equation.

$f(Q(A,a,D,\sigma,c))$: Q depends on A, a, D, σ , c. The equation used to compute Q for each item is derived in Addendum 2 and the equation contains all of these parameters.

$f(\beta(K,\sigma,Q))$: β depends on K, σ , and Q. The expected backorders depends on the variability of demands (K, σ) and the quantity ordered.

$f(A(c,Q))$: A depends on c and Q. The ordering cost depends on the dollar value per PRON (which is equal to c times Q); if the PRON value is greater than \$10,000, a higher ordering cost is incurred.

ADDENDUM 2

In general, let x_i be equal to any of the variables A_i , Q_i , D_i , a_i , c_i , μ_i , K_i , σ_i , Z_i , or β , so that the Lagrangian Method can be demonstrated. The Lagrange Function is:

EQ B-1

$$L(\lambda, x_1, x_2, x_3, \dots, x_n) = TC(x_1, x_2, \dots, x_n) - \lambda(\text{constraint eq.})$$

$$= \sum_{i=1}^n \frac{A_i D_i}{Q_i} + \sum_{i=1}^n a_i c_i \left(\mu_i + K_i \sigma_i + \frac{Q_i}{2} \right) - \lambda \left[\sum_{i=1}^n \frac{0.5 Z_i \sigma_i^2}{2Q_i} (\exp(-\sqrt{2}K_i)) - \beta \right]$$

where λ is the rate of decrease in TVC with respect to the constraint. The partial derivative of the Lagrange eq with respect to λ is

EQ B-2

$$\frac{\partial L}{\partial \lambda} = - \sum_{i=1}^n \frac{0.5 Z_i \sigma_i^2}{2Q_i} \exp(-\sqrt{2}K_i) + \beta$$

Note that for ease of manipulation, the subscript i will not be shown again until the last equation.

Optimum values of K and λ can be found by equating the respective first partial derivatives to zero.

Optimum values of K and λ are found as follows:

$$\frac{\partial L}{\partial K} = ac\sigma - \lambda \frac{0.5Z\sigma^2}{2Q} (-\sqrt{2})\exp(-\sqrt{2}K)$$

set $\frac{\partial L}{\partial K}$ equal to zero and solve for K

$$\exp(-\sqrt{2}K) = \frac{-2Qac\sigma}{\sqrt{2} 0.5Z\sigma^2 \lambda}$$

EQ B-3

$$K = -\frac{1}{\sqrt{2}} \ln \left[-\frac{\sqrt{2} Qac}{0.5Z\sigma\lambda} \right]$$

$$\frac{\partial L}{\partial \lambda} = -\frac{0.5Z\sigma^2}{2Q} \exp(-\sqrt{2}K) + \beta$$

setting $\frac{\partial L}{\partial \lambda}$ equal to zero and solving for K yields

EQ B-4

$$K = -\frac{1}{\sqrt{2}} \ln \left[\frac{2Q\beta}{0.5Z\sigma^2} \right]$$

Substituting the value for K into EQ B-3 and solving for (-λ) yields

$$K = -\frac{1}{\sqrt{2}} \ln \left[\frac{2Q\beta}{0.5Z\sigma^2} \right] = -\frac{1}{\sqrt{2}} \ln \left[-\frac{\sqrt{2}Qac}{0.5Z\sigma\lambda} \right]$$

$$\frac{2Q\beta}{0.5Z\sigma^2} = -\frac{\sqrt{2}Qac}{0.5Z\sigma\lambda}$$

EQ B-5

$$(-\lambda) = \frac{ac\sigma}{\sqrt{2}\beta}$$

Optimal values of Q can be found in a similar manner

$$\frac{\partial L}{\partial Q} = \frac{-AD}{Q^2} + \frac{ac}{2} + \frac{0.5Z\sigma^2\lambda}{2Q^2} \exp(-\sqrt{2}K)$$

$$\text{where } K = -\frac{1}{\sqrt{2}} \ln \left[\frac{2Q\beta}{0.5Z\sigma^2} \right]$$

$$\text{and } (-\lambda) = \frac{ac\sigma}{\sqrt{2}\beta}$$

$$\frac{\partial L}{\partial Q} = \frac{-AD}{Q^2} + \frac{ac}{2} - \left(\frac{0.5Z\sigma^2}{2Q^2} \right) \left(\frac{ac\sigma}{\sqrt{2}\beta} \right) \exp \left[-\sqrt{2} \left(-\frac{1}{\sqrt{2}} \ln \frac{2Q\beta}{0.5Z\sigma^2} \right) \right]$$

$$\frac{\partial L}{\partial Q} = \frac{-AD}{Q^2} + \frac{ac}{2} - \frac{ac\sigma}{\sqrt{2}Q}$$

Setting $\frac{\partial L}{\partial Q}$ equal to zero and solving for Q yields

$$0 = -\frac{AD}{Q^2} + \frac{ac}{2} - \frac{ac\sigma}{\sqrt{2}Q}$$

$$0 = -AD + \frac{acQ^2}{2} - \frac{ac\sigma Q}{\sqrt{2}}$$

$$Q^2 - \sqrt{2}\sigma Q - \frac{2AD}{ac} = 0$$

$$Q = \frac{\sqrt{2}\sigma \pm \sqrt{2\sigma^2 - (4)(-\frac{2AD}{ac})}}{2}$$

EQ B-6

$$Q_1 = \frac{\sigma_1}{\sqrt{2}} \pm \sqrt{\frac{2A_1 D_1}{a_1 c_1} + \left(\frac{\sigma_1}{\sqrt{2}}\right)^2}$$

ADDENDUM 3

The partial derivative of Q_1 with respect to A_1 is derived in this addendum. The equation for Q_1 , as found in Addendum 2, is as follows:

$$Q_1 = \frac{q}{\sqrt{2}} \pm \sqrt{\frac{2A_1 D_1}{ac} + \left(\frac{\sigma_1}{\sqrt{2}}\right)^2}$$

The derivative using either the plus or minus sign yields the same result.

using the plus sign

using the minus sign

EQ C-1

$$Q = \frac{\sigma}{\sqrt{2}} + \sqrt{\frac{2AD}{ac} + \left(\frac{\sigma}{\sqrt{2}}\right)^2}$$

$$Q = \frac{\sigma}{\sqrt{2}} - \sqrt{\frac{2AD}{ac} + \left(\frac{\sigma}{\sqrt{2}}\right)^2}$$

EQ C-2

$$\frac{\partial Q}{\partial A} = 0 + \frac{\frac{1}{2}(2D)}{\sqrt{\frac{2AD}{ac} + \left(\frac{\sigma}{\sqrt{2}}\right)^2}}$$

$$\frac{\partial Q}{\partial A} = 0 - \frac{\frac{1}{2}(2D)}{\sqrt{\frac{2AD}{ac} + \left(\frac{\sigma}{\sqrt{2}}\right)^2}}$$

manipulating equation C-1 yields:

EQ C-3

$$Q - \frac{\sigma}{\sqrt{2}} = \sqrt{\frac{2AD}{ac} + \left(\frac{\sigma}{\sqrt{2}}\right)^2}$$

$$-\left(Q - \frac{\sigma}{\sqrt{2}}\right) = \sqrt{\frac{2AD}{ac} + \left(\frac{\sigma}{\sqrt{2}}\right)^2}$$

substituting equation C-3 into equation C-2 yields:

EQ C-4

$$\frac{\partial Q_1}{\partial A_1} = \frac{D_1}{a_1 c_1 \left(Q_1 - \frac{\sigma_1}{\sqrt{2}}\right)}$$

$$\frac{\partial Q_1}{\partial A_1} = \frac{D_1}{a_1 c_1 \left(Q_1 - \frac{\sigma_1}{\sqrt{2}}\right)}$$

ADDENDUM 4

C FOR ARRCOM MANAGED, STOCKED SECONDARY ITEMS,
C THIS PROGRAM COMPUTES THE FOLLOWING:
C 1. NUMBER OF STOCKED ITEMS (N)
C 2. AVERAGE VALUE OF REORDER QUANTITY (C TIMES Q)
C 3. AVERAGE FREQUENCY OF REPLENISHMENT ACTIONS (D DIVIDED BY Q)
C 4. CHANGE IN TOTAL VARIABLE COST AS ORDERING COSTS CHANGE
C THE ABOVE ARE PERFORMED FOR THESE TWO DOLLAR VALUE CLASSIFICATIONS:
C 1. WHEN (C TIMES Q) IS GREATER THAN OR EQUAL TO \$10,000.
C 2. WHEN (C TIMES Q) IS LESS THAN \$10,000.

C DEFINITIONS OF PARAMETERS:

C UPRICE = UNIT PRICE

C RQTY = REORDER CYCLE QUANTITY

C AMT = UPRICE * RQTY = C * Q

C RMOS = REORDER CYCLE MONTHS

C OF = ORDER FREQUENCY = 12 / RMOS = D / Q

C N = NUMBER OF ITEMS

C TVC = DERIVATIVE OF TOTAL VARIABLE COST WITH RESPECT TO ORDER COST

C H OR L ON END OF ABOVE PARAMETERS INDICATES HIGH(H) \$ VALUE

C (> OR = \$10K) OR LOW(L) \$ VALUE (< \$10K)

```

DATA NH,NL/2#0/
DATA AMTH,AMTL,OFH,OFL,TVCH,TVCL/6#0.0/
5 READ(5,10,END=30)FIACD1,IMPC1,UPRICE,RMOS,RQTY
10 FORMAT(A1,A1,F9.2,F3.1,F9.0)
IF(FIACD1 .EQ. M .AND. IMPC1 .EQ. 1) GO TO 15
GO TO 5
15 AMT = UPRICE * RQTY
IF(AMT .LE. 0.0 .OR. RMOS .LE. 0.0)GO TO 5
OF = 12.0 / RMOS
IF(AMT .LT. 10000)GO TO 20
NH = NH + 1
AMTH = AMTH + AMT
OFH = OFH + OF
TVCH=TVCH+1.5*OF-1372.0*(OF**2)/(0.23*AMT)
GO TO 5
20 NL = NL + 1
AMTL = AMTL + AMT
OFL = OFL + OF
TVCL=TVCL+1.5*OF-335.0*(OF**2)/(0.23*AMT)
GO TO 5
30 AMTH = AMTH / NH
OFH = OFH / NH
AMTL = AMTL / NL
OFL = OFL / NL
WRITE(6,35)NH,AMTH,OFH,TVCH
WRITE(6,35)NL,AMTL,OFL,TVCL
35 FORMAT(3X,I8,5X,F12.2,5X,F6.2,5X,F12.2)
CALL EXIT
END

```

Appendix B

LIST OF ELEMENTS IN VCP PARAMETERS

APPENDIX B. LIST OF ELEMENTS IN VCP PARAMETERS

This appendix contains the list of elements to be included in the cost to procure parameters as outlined in C17, AR 710-1, 1 Apr 80. Appendix B. The list of elements was used as guidance throughout this study; however, data was not gathered for each and every data element since it was convenient to group several elements into general categories.

Section II. FUNCTIONAL ELEMENTS TO BE INCLUDED IN COST TO PROASURE

I. DIRECT LABOR/ADP COSTS PER ITEM PROCURED AT MRC
 (Exclusive of Any Contract Administration Function Not Listed)

A.	Processing Procurement Work Directive to Procurement	Labor	ADP
1.	Preparation of Documents Which Recommend the Buy	\$ _____	_____
2.	Item Manager Review if Applicable	_____	_____
3.	Preparation of PWD	_____	_____
4.	Supervisory Review	_____	_____
5.	Accounting Effort Related to Initiation, Commitment and Obligation of Funds	_____	_____
6.	Establishment and Maintenance of Due-In Records	_____	_____
7.	Internal Control of PWD	_____	_____
8.	Technical Coordination Associated with PWD Preparation. (Does not include cost of maintaining technical data, files, but does include cost of adding technical data to the PWD whether accomplished manually or by automated process.) May include:		
a.	Cataloging and Standardization Review	(_____) (_____)	
b.	Determination of Quality Control Provisions to be Inserted in Contract	(_____) (_____)	
c.	Technical Decisions Concerning Source (Com- petitive Versus Noncompetitive) and Engineer- ing Data Requirements	(_____) (_____)	
d.	Packing and Preservation Review	(_____) (_____)	
e.	Provisioning Data Screening	(_____) (_____)	
f.	Legal Review	(_____) (_____)	
g.	Transportation Data Review	(_____) (_____)	
h.	Review of Technical Handbook Adequacy	(_____) (_____)	

B. Purchase

Either subparagraphs 1 or 2 below will apply for the "purchase" function, depending on whether the value is below or above \$10,000.

1. For Small Purchase Items (less than \$10,000)	Labor	ADP
a. Receipt and Recording of PWD	\$ _____	_____
b. Solicitation Effort	_____	_____
(1) PWD Review	(____)	(____)
(2) Determination of Method of Procurement	(____)	(____)
(3) Obtain Source List	(____)	(____)
(4) Draft and Type Solicitation	(____)	(____)
(5) Accomplish Solicitation	(____)	(____)
c. Evaluation and Award Effort	(____)	(____)
(1) Price/Cost Analysis	(____)	(____)
(2) Selection of Contractor	(____)	(____)
(3) Draft and Type Contract	(____)	(____)
(4) Purchase Office Review	(____)	(____)
(5) Legal Review	(____)	(____)
(6) Distribution of Contract	(____)	(____)
2. For All Other Items <i>(For Call-Type Contracts, include only those functions relating to the processing of orders.)</i>		
a. Receipt and Recording of PWD and Assignment of Buyer	_____	_____
b. Solicitation Effort	(____)	(____)
(1) Procurement Planning	(____)	(____)
(2) PWD Review and Small Business Coordination	(____)	(____)
(3) Determination and Finding	(____)	(____)

1 April 1980

	Labor	ADP
(4) Determination of Type Contract	(____)	(____)
(5) Synopsis and/or Preliminary Invitation Notice	(____)	(____)
(6) Draft and Type Solicitation	(____)	(____)
(7) Accomplish Solicitation	(____)	(____)
c. Evaluation and Award Effort	_____	_____
(1) Receive Quotes and Proposals	(____)	(____)
(2) Opening of Bids	(____)	(____)
(3) Evaluation (Technical, Procurement, Production Transportation)	(____)	(____)
(4) Selection of Probable Contractor	(____)	(____)
(5) Selection of Contractor	(____)	(____)
(6) Procurement/Legal Review	(____)	(____)
(7) Draft and Type Contract	(____)	(____)
(8) Process Administrative Commitment Document	(____)	(____)
(9) Forwarding of Contract to Contractor for Signature	(____)	(____)
(10) Receipt of Contract and Final Review, Signature	(____)	(____)
(11) Obligation of Funds	(____)	(____)
(12) Distribution of Contract and Final Administrative Procedures	(____)	(____)
C. Receipt and Payment	\$ _____	\$ _____
1. Runload and Check-in of Materiel Received	_____	_____
2. Quality Inspection	_____	_____
3. Matching Receipt Papers	_____	_____
4. Relocation of Materiel During Receipt Processing	_____	_____
5. Movement of Materiel to Warehouse	_____	_____

1 April 1980

C17, AR 710-1

	Labor	ADP
6. Updating Storage Location and Asset Records	_____	_____
7. Updating MRC Asset Records	_____	_____
8. Processing DD Form 250 (Material Inspection and Receiving Report) and Invoices for Payment	_____	_____
9. Other Financial Effort Related to Payment	_____	_____

II. DIRECT LABOR/ADP COST PER ITEM ADMINISTERED AT A DEFENSE CONTRACT ADMINISTRATION SERVICES REGION (DCASR)

note: These costs will be determined by Defense Contract Administration Services (DCAS) and Defense Contract Audit Agency (DCAA) and published by OASD(I&L) for use by all Military Departments and the Defense Supply Agency

	Labor	ADP
A. Initial File Establishment	\$ _____	\$ _____
B. Pre-award Survey	_____	_____
C. Price/Cost Analyses	_____	_____
D. Production Follow-up	_____	_____

III. LABOR BENEFIT COSTS (See DODI 7041.3)

A. Personnel benefits (health insurance, retirement, life insurance, disability) will be computed at 8 percent of direct labor cost.

B. Leave entitlements to cover sick and annual leave, holiday leave, administrative leave will be computed at 21 percent of direct labor cost.

IV. INDIRECT LABOR/SUPPORT COSTS NOT INCLUDED IN I AND II

	TOTALS,\$
A. Communication Costs (Autodin, Telephone, Teletype)	_____
B. Internal Reproduction Equipment Rental	_____
C. Cost of Printing PWD and Contracts	_____
D. Materiel and Supplies	_____
E. Cost of Mail	_____
F. Data Service (Key Punch, Sort, the Variable Automatic Data Processing Costs Associated with Each Function)	_____

C17,AR 710-1

1 April 1980

G. Personnel Support (Civilian Personnel Office)

Totals,\$

V. TOTAL VARIABLE COST TO PROCURE

Sum of Direct Labor/ADP Cost at MRC

Sum of Direct Labor/ADP Cost at DCASAR

Sum of Labor Benefit Cost

Sum of Indirect Labor/Support Costs

TOTAL

Appendix C

VCP COMPUTER PROGRAM DOCUMENTATION

APPENDIX C. VCP COMPUTER PROGRAM DOCUMENTATION

This appendix contains 4 sections as follows:

	<u>Page</u>
SECTION C-1: VCP Computer Program	C-2
SECTION C-2: Example of Directorate Input File	C-9
SECTION C-3: Example of Parameter Input File	C-10
SECTION C-4: Sample Output	C-11

SECTION C-1. VCP COMPUTER PROGRAM

C VARIABLE COST TO PROCURE (VCP)

C THIS PROGRAM IS USED TO DETERMINE THE VCP PARAMETERS.
C IT CALLS UPON 15 DIFFERENT INPUT FILES, 14 OF WHICH CONTAIN
C SPECIFIC DATA FOR VARIOUS DIRECTORATES/OFFICES.
C THE OTHER FILE CONTAINS ALL OTHER PARAMETERS NEEDED TO
C EXECUTE THIS PROGRAM, INCLUDING SUCH THINGS AS AVERAGE
C SALARIES PER GRADE LEVEL, NUMBER OF PWDS PROCESSED, ETC.

C EACH DIRECTORATE/OFFICE FILE IDENTIFIES: A) GRADE LEVELS
C (EG. GS11), B) NUMBER OF SLOTS AT THAT GRADE, C) PERCENT
C OF TIME SPENT ON PROCESSING SECONDARY ITEM PWDS, D) RATIO
C OF EFFORT TO PROCESS ONE LDV PWD VERSUS ONE HDV PWD,
C AND E) OFFICE SYMBOL (EG. DRSAR-PCS-S).

C THE INPUT FILE TITLED "PARAMS" (SHORT FOR PARAMETERS) INCLUDES:
C A) THE YEAR OF THE BUDGET DOLLARS, B) SALARIES FOR THE GENERAL
C SCHEDULES, STEP 5, FOR GS01 THRU GS15, C) SALARIES FOR OFFICERS
C O1 THRU O7, SALARIES FOR ENLISTED E1 THRU E9, D) NUMBER OF LDV AND
C HDV SECONDARY ITEM PWDS PROCESSED IN A YEAR PERIOD, E) ANNUAL ADP
C COSTS, F) ANNUAL SUPPLY COSTS IN -PC AND -LE, PLUS TOTAL AUTHORIZED
C PERSONNEL IN -PC, G) ANNUAL LONG DISTANCE PHONE CALLS IN -PCS,
C H) ESTIMATED POSTAGE COST PER PWD, I) TOTAL NUMBER OF PERSONNEL SERVED
C BY THE CIVILIAN PERSONNEL OFFICE, AND G) DCAS COST FOR LDV AND
C HDV PWDS.

```
REAL NPWDL,NPWDH
REAL LDCALL
REAL LABBEN
REAL*8 COST
DIMENSION CSS(15), OFF(7), ESAL(9), COST(14,4), CODE(14), TOT(4)
DIMENSION LABBEN(4),ENPL(14), ENPH(14), ENP(14)
DATA ENPL,ENPH,ENP/42*0.0/
DATA TENPL,TENPH,TENP/3*0.0/
DATA COST/56 * 0.0/
DATA TOT/4*0.0/
DATA CPOLT,CPOHT/2*0.0/
DATA S,O,E/.S...O...E./
DATA CODE/.MM.,.PC.,.LE.,.CP.,.QA.,.TM.,.GC.,.MS.,.PD.,.PP.,.SB.,
$ .SF.,.SL.,.CO./
```

C SL IS FOR SBALO AND CO IS FOR SARRI-PT.

I=0

CALL SEARCH(1,.PARAMS.,1,0)

READ(5,18) YEAR

18 FORMAT(A4)

C INITIALIZE GENERAL SCHEDULE SALARIES USING STEP 5 RATES.

DO 19 J=1,15

19 READ(5,20) CSS(J)

20 FORMAT(F6.0)

C INITIALIZE MILITARY SALARIES.
DO 21 J=1,7
21 READ(5,20) OFF(J)
DO 22 J=1,9
22 READ(5,20) ESAL(J)

C
C INITIALIZE RPWDL AND RPWDH, INDICATING THE NUMBER OF LDV AND
C HDV SECONDARY ITEM REPLENISHMENT PWDS PROCESSED BY ARRCOM,
C RESPECTIVELY, DURING A FISCAL YEAR (E.G. FY80).
READ(5,20) RPWDL
READ(5,20) RPWDH

C
C INITIALIZE PPWDL AND PPWDH, INDICATING THE NUMBER OF SECONDARY ITEM
C PROVISIONING PWDS PROCESSED BY ARRCOM DURING A FISCAL YEAR(E.G. FY80).
READ(5,20) PPWDL
READ(5,20) PPWDH

C
C READ TOTAL ADP COST FOR ONE YEAR.
READ(5,23) ADPT
23 FORMAT(F8.0)

C
C READ TOTAL SUPPLY COSTS FOR A YEAR IN THE PROCUREMENT (SUPPC),\$/PWD
C IN LOGISTICS ENGINEERING (SULE) DIRECTORATES. ALSO READ TOTAL
C AUTHORIZED PEOPLE IN THE PROCUREMENT DIRECTORATE (TOT PC).
READ(5,24) SUPPC,TOTPC,SULE
24 FORMAT(F8.0,3X,F8.0,3X,F8.3)

C
C READ TOTAL LONG DISTANCE CALLS FOR A YEAR.
READ(5,20) LDCALL

C
C READ COST PER PWD FOR POSTAGE.
READ(5,26) PMAIL
26 FORMAT(F6.2)

C
C READ TOTAL NUMBER PEOPLE SERVED BY CIVILIAN PERSONNEL OFFICE.
READ(5,20) TOTPL

C
C READ COST PER PWD FOR DCASR FOR LDV AND HDV PWDS.
READ(5,25) DCASLP,DCASHP
25 FORMAT(F8.2,3X,F8.2)
CALL SEARCH(4,0,1,0)

C
C OPEN AND CLOSE FILE SECTION.

C
CALL SEARCH (1,.MMFILE.,1,0)
GO TO 100

1 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,.PCFILE.,1,0)
GO TO 100

2 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,.LBFILE.,1,0)
GO TO 100

```
3 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'CPFFILE',1,0)
GO TO 100
4 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'QAFILE',1,0)
GO TO 100
5 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'IMFILE',1,0)
GO TO 100
6 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'GCFILE',1,0)
GO TO 100
7 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'MSFILE',1,0)
GO TO 100
8 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'PDFILE',1,0)
GO TO 100
9 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'PPFILE',1,0)
GO TO 100
10 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'SBFILE',1,0)
GO TO 100
11 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'SPFILE',1,0)
GO TO 100
12 CALL SEARCH (4,0,1,0)
CALL SEARCH (1,'SBALOF',1,0)
GO TO 100
C
C      MAIN PROGRAM
C
100 I=I+1
C      READ PERCENTAGE OF PROVISIONING PWDS PROCESSED BY THE
C      EMPLOYEES LISTED IN THIS DIRECTORATE FILE.
C      READ(5,103) PCTPRL,PCTPRH
103 FORMAT(2F5.2)
C
C      DETERMINE TOTAL NUMBER OF PWDS PROCESSED BY THIS OFFICE.
NPWDL = RPWDL + PCTPRL * PPWDL
NPWDH = RPWDH + PCTPRH * PPWDH
C
C      DETERMINE PERCENT OF REPLENISHMENT PWDS TO TOTAL PWDS
C      THAT ARE PROCESSED IN THIS OFFICE.
PCTRL = RPWDL / NPWDL
PCTRH = RPWDH / NPWDH
105 READ (5,106,END=140) TYPE, IG, NSLOTS, APPPCIT, RL, RH
106 FORMAT (2X,A1,I2,I2,2X,F3.2,2X,F3.2,2X,F3.2)
```

```

C DETERMINE WEIGHTING FACTOR (WFL AND WFH) BASED ON RATIO AND
C THE NUMBER OF LDV AND HDV PWDS.
WFL=((NPWDL*RL)/((NPWDL*RL)+(NPWDH*RH)))
WFH=1.-WFL
C DETERMINE NUMBER OF EMPLOYEES (EPL AND EPH) FOR EACH TDA LINE
C NUMBER WHICH EXPEND EFFORT IN PROCESSING SECONDARY ITEM
C REPLENISHMENT PWDS.
EPL = NSLOTS * APPPCT * WFL * PCTRL
EPH = NSLOTS * APPPCT * WFH * PCTRH
C SUMMARIZE THE NUMBER OF EQUIVALENT EMPLOYEES PER DIRECTORATE.
ENPL(I) = ENPL(1) + EPL
ENPH(I) = ENPH(1) + EPH
C ANNUAL SALARIES ARE DIVIDED BY 1.21 IN ORDER TO REMOVE THE COSTS
C OF ANNUAL, SICK, & ADMINISTRATIVE LEAVE, WHICH ARE ACCOUNTED
C FOR LATER.
IF(TYPE.EQ.S) SAL = GSS(IG) / 1.21
IF(TYPE.EQ.O) SAL = OFF(IG) / 1.21
IF(TYPE.EQ.E) SAL = ESAL(IG) / 1.21
C SUMMARIZE THE ANNUAL COST EXPENDED PER DIRECTORATE.
COST(I,1) = COST(I,1) + SAL * EPL
COST(I,2) = COST(I,2) + SAL * EPH
GO TO 105
C NEXT, THE AVERAGE COSTS ARE COMPUTED FOR PROCESSING LDV AND HDV
C REPLENISHMENT PWDS.
140 COST(I,3)=COST(1,1)/RPWDL
COST(I,4)=COST(1,2)/RPWDH
DO 145 J=1,4
C SUMMARIZE COSTS FOR HEADQUARTERS.
145 TOT(J) = TOT(J) + COST(I,J)
GO TO (1,2,3,4,5,6,7,8,9,10,11,12,150),I
150 CONTINUE
C SUMMARIZE EQUIVALENT NUMBER OF EMPLOYEES FOR HEADQUARTERS.
DO 155 I=1,13
ENP(I) = ENPL(I) + ENPH(I)
TENPL = TENPL + ENPL(I)
TENPH = TENPH + ENPH(I)
155 CONTINUE
TENP = TENPL + TENPH
C OUTPUT SECTION.
C CALL SEARCH(4,0,1,0)
CALL SEARCH(2,.VCPOUT.,2,0)

```

```

      WRITE(6,160) YEAR
160 FORMAT(T2,,VARIABLE COST TO PROCURE FOR SECONDARY ITEM.,
$ REPLENISHMENT PWDS(IN .,A4,, DOLLARS),/T2,
$ 79(.-.),//T20,.COST PER PWD.,T51,.ANNUAL COSTS.,/T20,12(.-.),
$ T51,12(.-.),/T14,2(. LDV PWDS HDV PWDS .,6X),/T14,
$ 2(10(.-.),4X,11(.-.),6X),/T3,.1.LABOR.,)
      DO 165 I=1,13
165 WRITE(6,170) CODE(I),COST(I,3),COST(I,4),COST(I,1),COST(I,2)
170 FORMAT(4X,A2,4X,F11.2,4X,F11.2,6X,F11.0,4X,F11.0)
      WRITE(6,180) TOT(3),TOT(4),TOT(1),TOT(2)
180 FORMAT(T15,7(.-.),T30,7(.-.),T45,9(.-.),T60,9(.-.),/4X,.TOTALS.,
$ F11.2,4X,F11.2,6X,F11.0,4X,F11.0)

C      DETERMINE LABOR BENEFITS AT 29% OF LABOR COSTS.
C      DO 185 I=1,4
185 LABBEN(I)=0.29*TOT(I)
      WRITE(6,190) LABBEN(3),LABBEN(4),LABBEN(1),LABBEN(2)
190 FORMAT(/T3,.2.BENEFITS.,/T5,.AT 29%,F11.2,4X,F11.2,6X,
$ F11.0,4X,F11.0)

C      DETERMINE PERCENT OF LDV AND HDV PWDS.
C      PTPWDL=NPWDL/(NPWDL+NPWDH)
C      PTPWDH=1.--PTPWDL

C      DETERMINE ADP COSTS IN EACH CATEGORY (LDV AND HDV).
ADPWDL = ADPT / (RPWDL + RPWDH)
ADPWDH = ADPWDL
ADPLT = ADPWDL * RPWDL
ADPHT = ADPWDH * RPWDH
      WRITE(6,195) ADPWDL,ADPWDH,ADPLT,ADPHT
195 FORMAT(/T3,.3.ADP.,3X,F11.2,4X,F11.2,6X,F11.0,4X,F11.0)

C      DETERMINE SUPPLY COSTS IN EACH CATEGORY.
C      THE SUPPLIES IN -PC ARE PRORATED ACCORDING TO THE NUMBER OF
C      EQUIVALENT EMPLOYEES PROCESSING SECONDARY ITEM PWDS.
C      THE SUPPLIES IN -LE ARE PRORATED ACCORDING TO THE NUMBER OF
C      PWDS PROCESSED IN EACH CATEGORY.
SUPLT=SUPPC*(ENPL(2)/TOTPC)+SUPLE*RPWDL
SUPHT=SUPPC*(ENPH(2)/TOTPC)+SUPLE*RPWDH
SUPLP=SUPLT/RPWDL
SUPHP=SUPHT/RPWDH
      WRITE(6,200) SUPLP,SUPHP,SUPLT,SUPHT
200 FORMAT(/T3,.4.SUPPORT.,/T5,.A.SPLYS.,F10.2,4X,F11.2,6X,F11.0,4X,
$ F11.0)

C      PRORATE LONG DISTANCE PHONE CALLS ACCORDING TO NUMBER OF
C      SECONDARY ITEM PWDS PROCESSED.
CALLLP = LDCALL / (RPWDL + RPWDH)
CALLHP = CALLLP
CALLLT = CALLLP * RPWDL
CALLHT = CALLHP * RPWDH

```

```

      WRITE(6,205) CALLLP,CALLHP,CALLLT,CALLHT
205 FORMAT(T5,'B.LD CALLS',F7.2,4X,F11.2,6X,F11.0,4X,F11.0)
C
C   DETERMINE TOTAL MAIL COSTS.
TMAILL=PMAIL*RPWDL
TMAILH=PMAIL*RPWDH
WRITE(6,210) PMAIL,PMAIL,TMAILL,TMAILH
210 FORMAT(T5,'C.MAIL',F11.2,4X,F11.2,6X,F11.0,4X,F11.0)
C
C   A PERCENT OF THE CIVILIAN PERSONNEL OFFICE (CPO) IS ADDED TO
C   THE VCP PARAMETERS. THAT PERCENT IS FOUND FOR EACH DOLLAR
C   CATEGORY BY DIVIDING THE EQUIVALENT NUMBER OF EMPLOYEES BY THE
C   TOTAL NUMBER OF EMPLOYEES SERVED BY THE CPO, AS FOLLOWS:
PCTL=TENPL/TOTPL
PCTH=TENPH/TOTPL
CALL SEARCH (1,'CPOFIL',1,0)
215 READ(5,220,END=230) TYPE,1G,NSLOTS
220 FORMAT(2X,A1,12,1X,I2)
C   THE ANNUAL SALARIES ARE DIVIDED BY 1.21 TO REMOVE EFFECTS OF
C   LEAVE, AND THEN MULTIPLIED BY 1.29 TO INCLUDE LABOR BENIFITS
C   (BOTH LEAVE AND HEALTH BENEFITS).
IF(TYPE.EQ.S) SAL=GSS(IG) / 1.21 * 1.29
IF(TYPE.EQ.O) SAL=OFF(IG) / 1.21 * 1.29
IF(TYPE.EQ.E) SAL=ESAL(IG) / 1.21 * 1.29
C
C   DETERMINE TOTAL APPLICABLE COST FOR CPO.
CPOLT=CPOLT + SAL*NSLOTS*PCTL
CPOHT=CPOHT + SAL*NSLOTS*PCTH
GO TO 215
230 CALL SEARCH(4,0,1,0)
C
C   DETERMINE COST PER PWD FOR CPO.
CPOLP=CPOLT/RPWDL
CPOHP=CPOHT/RPWDH
WRITE(6,240) CPOLP,CPOHP,CPOLT,CPOHT
240 FORMAT(T5,'D.CPO',1X,F11.2,4X,F11.2,6X,F11.0,4X,F11.0)
C
C   DETERMINE SUM OF SUPPORT COSTS.
SPTLP=SUPLP + CALLLP + PMAIL + CPOLP
SPTHP=SUPHP + CALLHP + PMAIL + CPOHP
SPTLT=SUPLT + CALLLT + TMAILL + CPOLT
SPTHT=SUPHT + CALLHT + TMAILH + CPOHT
WRITE(6,245) SPTLP,SPTHP,SPTLT,SPTHT
245 FORMAT(T15,7('-'),T30,7('-'),T45,9('-'),T60,9('-'),/4X,'TOTALS',
$ F11.2,4X,F11.2,6X,F11.0,4X,F11.0)
C
C   DETERMINE ANNUAL DCASR COSTS
DCASLT=DCASLP*RPWDL
DCASHT=DCASHP*RPWDH
WRITE(6,250) DCASLP,DCASHP,DCASLT,DCASHT
250 FORMAT(/T3,'5.DCASR',1X,F11.2,4X,F11.2,6X,F11.0,4X,F11.0)
C

```

C DETERMINE VARIABLE COST TO PROCURE TOTALS.
VCPLP=TOT(3) + LABBEN(3) + ADPWDL+ SPTLP + DCASLP
VCPHP=TOT(4) + LABBEN(4) + ADPWDH+ SPTH + DCASHP
VCPLT=TOT(1) + LABBEN(1) + ADPLT + SPTLT + DCASLT
VCPHT=TOT(2) + LABBEN(2) + ADPHT + SPTHT + DCASHT
WRITE(6,245) VCPLP,VCPHP,VCPLT,VCPHT
255 FORMAT(/T15,7(.-.),T30,7(.-.),T45,9(.-.),T60,9(.-.),
\$/T4,,TOTAL, VCP.,F9.2,4X,F11.2,6X,F11.0,4X,F11.0,/,//72(*.))
WRITE(6,260)
260 FORMAT(///T20,.EQUIVALENT NUMBER OF EMPLOYEES.,//T18,. LDV PWDS .,
\$ 5X,, HDV PWDS .,5X,.TOTAL.)
DO 265 I=1,13
265 WRITE(6,270) CODE(I),ENPL(I),ENPH(I),ENP(I)
270 FORMAT(8X,A2,5X,F10.2,6X,F10.2,3X,F10.2)
WRITE(6,275) TENPL,TENPH,TENP
275 FORMAT(/8X,.TOTALS.,1X,F10.2,6X,F10.2,3X,F10.2)
CALL SEARCH(4,0,2,0)
CALL EXIT
END

SECTION C-3. EXAMPLE OF DIRECTORATE INPUT FILE

<u>POSITION</u>	<u>NSLOTS</u>	<u>PERCENT</u>	<u>RATIO</u>	<u>OFFICE SYMBOL</u>
GS-12	1	25%	1.0 1.0	DRSAR-XXXX
O-3	2	60%	0.0 1.0	DRSAR-XXXX
E-7	3	75%	1.0 0.0	DRSAR-XXXX
GS-04	1	50%	1.0 2.0	DRSAR-XXXX

The above sample input file means the following:

- a. POSITION: Identifies a grade level for both civilians and military.
- b. NSLOTS: Identifies the number of personnel at the specified grade level.
- c. PERCENT: Identifies the percent of time (both direct and indirect) which is expended in processing secondary item PWDs.
- d. RATIO: Identifies the ratio of effort to process one LDV PWD versus one HDV PWD. A ratio of 0.0 to 1.0 means that all effort is expended in processing HDV PWDs. A ratio of 1.0 to 2.0 means that twice as much effort is expended in processing a HDV PWD as compared to processing a LDV PWD.
- e. OFFICE SYMBOL: Identifies the office where the people work.

SECTION C-3. EXAMPLE OF PARAMETER INPUT FILE

FY81

8913. GS-1,STEP 5
9821. GS-2,STEP 5
11067. GS-3,STEP 5
12425. GS-4,STEP 5
13903. GS-5,STEP 5
15495. GS-6,STEP 5
17217. GS-7,STEP 5
19070. GS-8,STEP 5
21064. GS-9,STEP 5
23195. GS-10,STEP 5
25185. GS-11,STEP 5
30143. GS-12,STEP 5
36320. GS-13,STEP 5
42921. GS-14,STEP 5
50487. GS-15,STEP 5
20759. O-1
26101. O-2
31973. O-3
38319. O-4
45091. O-5
54077. O-6
59729. O-7
9296. E-1
10578. E-2
11650. E-3
12748. E-4
14656. E-5
17309. E-6
20324. E-7
23919. E-8
27910. E-9
5323. # OF LDV SECONDARY ITEM REPLENISHMENT PWDS
2122. # OF HDV SECONDARY ITEM REPLENISHMENT PWDS
3723. # OF LDV SECONDARY ITEM PROVISIONING PWDS
10241. # OF HDV SECONDARY ITEM PROVISIONING PWDS
73031. TOTAL ADP COST'S FOR A YEAR PERIOD.
62730. 531. 4.96 YRLY SPLY \$ IN -PC:TOT #-PC:\$/PWD IN -LIS
1197. YRLY LONG DISTANCE TELEPHONE CALLS -PC
7.99 POSTAGE COST PER PWD
7430. TOTAL # SERVED BY CIVILIAN PERSONNEL OFFICE
93.78 322.37 DCAS COST

SECTION C-4. SAMPLE OUTPUT

VARIABLE COST TO PRODUCE FOR SECONDARY ITEM REPLENISHMENT PWD (IN FY81 DOLLARS)

	COST PER PWD		ANNUAL COSTS	
	LDV PWDS	HDV PWDS	LDV PWDS	HDV PWDS
1. LABOR				
MM	113.37	321.99	603465.	603207.
PC	157.26	756.75	837096.	1605824.
LE	46.15	46.15	245633.	97921.
CP	46.32	46.32	246562.	98291.
QA	57.23	57.23	304634.	121442.
TM	1.31	1.31	6970.	2779.
OC	0.00	13.90	0.	29613.
MS	0.34	0.34	1793.	715.
PD	3.21	3.21	17079.	6809.
PP	21.57	23.39	114839.	49027.
SB	0.71	6.40	3783.	13574.
SF	0.11	0.11	589.	235.
SL	0.07	4.28	388.	9087.
TOTALS	447.65	1281.42	2382828.	2719180.
2. BENEFITS				
AT 29%	129.82	371.61	691020.	788562.
3. ADP	9.81	9.81	52215.	20810.
4. SUPPORT				
A. SPLYS	6.34	9.75	33728.	20693.
B. LD CALLS	0.16	0.16	856.	341.
C. MAIL	7.99	7.99	42531.	16955.
D. CPO	8.37	20.34	44535.	43166.
TOTALS	22.85	38.24	121650.	81155.
5. DCASR	93.78	322.37	499191.	684089.
TOTAL VCP	703.91	2023.46	3746904.	4293781.

Appendix D

ANALYSIS OF PRONS

APPENDIX D. ANALYSIS OF PRONS

This appendix presents the characteristics of the types, quantities, and dollar values of PRONs processed at ARRCOM during FY80. The data on issued PRONS were extracted from the Materiel Acquisition and Delivery File (MADISS File) of the Commodity Command Standard System (CCSS) on November 24, 1980. The following data elements were extracted from the MADISS File:

1. Procurement Request Order Number (PRON): a data chain used for identifying a procurement work directive (PWD)/work ordering documents and for controlling transactions.
2. PRON Amendment (PRON-AMD): a number used to identify a specific document that is changing the original.
3. Date Ordered (DT-ORD): the date on which a PWD, Delivery Order, or MIPR is generated. This date is not changed, even if the PRON is updated by subsequent amendments.
4. Delete Code (DEL-CD): indicates whether a PRON has been cancelled.
5. Financial Inventory Accounting Code (FIA-CD): used for establishing and maintaining monetary accounting for materiel, supplies, and equipment held as stock on records of property accountability in the Army supply system. Used also to identify a provisioning PRON and the weapon system the part is ordered for.
6. Total Order Amount (TOT-OR-AMT): the total dollar value of a PWD, Military Interdepartmental Purchase Request (MIPR) or Delivery Order Line Item. This amount is calculated by multiplying total order quantity by the current price.

The data were used in the following manner:

1. By keying on the date ordered (DT-ORD), a file was established for PRONs initiated in FY80.
2. By keying on the delete code (DEL-CD), PRONs which had already been cancelled before 24 Nov 80 were separated from the rest.
3. By keying on the second position of the FIA-CD, each file was subdivided into the files for Army Stock Fund (ASF) and PEMA Secondary Item PRONs, Ammunition PRONs, Principal Item PRONs, and O & MA PRONs.

4. By keying on the third position of the FIA-CD for the secondary item files, the provisioning PRONs were filed separately.
5. By keying on the fourth and fifth position of the FIA-CD for the provisioning PRONs, data for specific weapon systems can be identified.
6. By keying on the Total Order Amount (TOT-OR-AMT), all files were sorted so that the lowest dollar valued PRON came first and the highest dollar valued PRON came last.
7. Once these files were established,
 - a. The total number of PRONs and their total dollar value were obtained for each file, and
 - b. Statistics were obtained for each file which showed the cumulative number of PRONs which were less than specified dollar values, along with the associated cumulative dollar amounts of those PRONs. The cumulative percent of the total were also shown for both categories.

The results of the above process for FY80 data are shown in Tables D-1 through D-13. Similar results for FY77, FY78, and FY79 are displayed in several DRSAR-PES Memoranda^{a,b} (the computer programs used to obtain the results are also documented^b). The data in the tables are for FY80 active PRONs (as of 24 Nov 80) for the following categories:

Table D-1: Summary of FY80 PRON Data
Table D-2: ASF PRONS valued \geq \$10K
Table D-3: ASF PRONS valued < \$10K
Table D-4: ASF PRONS (no dollar limits)
Table D-5: PAS PRONS valued \geq \$10K
Table D-6: PAS PRONS valued < \$10K

^aMFR, DRSAR-PES, 18 JUN 1979, subject: Analysis of PRONs Which Were Initiated During FY78 and FY77.

^bMFR, DRSAR-PES, 29 APR 1980, subject: Analysis of PRONs Initiated at HQ, ARRCOM.

Table D-7: PAS PRONs (no dollar limits)

Table D-8: Secondary Item PRONs (ASF + PAS)

Table D-9: Secondary Item PRONs, provisioning only

Table D-10: Secondary Item PRONs, excluding provisioning PRONs

Table D-11: Principal End Item PRONs

Table D-12: Ammunition PRONs

Table D-13: O & MA PRONs

TABLE D-1. SUMMARY OF FY80 PPON DATA^a

	ARMY STOCK FUND <\$10K >\$10K	PEMS <\$10K \$10K	SEC >\$10K	SECONDARY ITEMS	AMMO	PPON	OPM	TOTAL
1. FOR ACTIVE^b PPONS								
a. Quantity	8,829	2,606	216	541	12,192	5,284	2,831	652
b. Cumulative \$ Account (\$K)	21	236	1	88	347	1,450	895	58
c. Ave \$ Value/PPON (\$K)	2.5	90.6	4.1	163.3	28.4	274.5	316.6	104.2
								131.8
2. FOR CANCELLED PPONS								
a. Quantity	1,279	272	154	263	1,973	716	297	63
b. Cumulative \$ Account (\$K)	2	24	1	34	60	279	68	4
c. Ave \$ Value/PPON (\$K)	1.9	89.0	4.4	127.0	31.2	389.1	227.8	65.1
								135.1

^aData was extracted from the CCSS (MADESS FILE) on 24 Nov 80.

^bActive means that the PPON had not been cancelled before 24 Nov 80.

TABLE D-2 . FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) ASF ITEM PRONS VALUED \geq \$10K

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
10K	1	~	10K	~
15K	597	22%	7M	3%
20K	933	36%	13M	6%
50K	1,809	69%	40M	17%
100K	2,204	85%	68M	29%
200K	2,392	92%	95M	40%
500K	2,528	97%	138M	58%
1M	2,571	98.7%	168M	71%
5M	2,605	99.96%	230M	97%
6.53M	2,606	100%	236M	100%

TABLE D-3. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) ASF ITEM PRONS VALUED < \$10K

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	149	2%	4K	~
100	484	5%	32K	0.1%
500	2,487	28%	545K	2.5%
1K	3,774	43%	1.5K	7%
2.5K	5,660	64%	4.6K	21%
5K	7,249	82%	10.3K	48%
10K	8,829	100%	21.7K	100%

TABLE D-4. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) ASF ITEM PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	149	1%	4K	~
100	484	4%	32K	~
500	2,487	22%	0.5M	0.2%
1K	3,774	33%	1.5M	0.6%
2.5K	5,660	49%	4.5M	1.8%
5K	7,249	63%	10M	4%
10K	8,830	77%	22M	8%
15K	9,426	82%	29M	11%
20K	9,762	85%	35M	13%
50K	10,638	93%	62M	24%
100K	11,033	96%	90M	35%
200K	11,221	98%	117M	45%
500K	11,357	99.3%	159M	62%
1M	11,400	99.7%	190M	74%
5M	11,434	99.99%	251M	97%
6.53M	11,435	100%	258M	100%

TABLE D-5. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) PA SECONDARY PRONS VALUED > \$10K

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
15K	57	11%	0.7M	0.8%
20K	95	18%	1.4M	1.6%
50K	235	43%	6M	7%
100K	356	66%	15M	16%
200K	435	80%	26M	29%
500K	506	94%	48M	54%
1M	532	98%	65M	73%
5M	540	99.8%	82M	93%
6.6M	541	100%	88M	100%

TABLE D-6. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) PA SECONDARY PRONS VALUED < \$10K

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	5	2%	0.2K	~
100	7	3%	0.3K	~
500	22	10%	4K	0.5%
1K	33	15%	12K	1.3%
2.5K	71	33%	83K	9%
5K	139	64%	332K	37%
10K	216	100%	895K	100%

TABLE D-7. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) PA SECONDARY PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	5	0.7%	~	~
100	7	0.9%	~	~
500	22	3%	4K	~
1K	33	4%	12K	~
2.5K	71	9%	83K	0.1%
5K	139	18%	332K	0.4%
10K	216	29%	895K	1%
15K	273	36%	1.6M	2%
20K	311	41%	2.3M	3%
50K	451	60%	6.9M	8%
100K	572	76%	15M	17%
200K	651	86%	26M	30%
500K	722	95%	48M	54%
1M	748	98.8%	66M	74%
5M	756	99.9%	83M	93%
6.6M	757	100%	89M	100%

TABLE D-8. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) SECONDARY ITEM PRONS

<u>\$ AMT/PRONS</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	154	1%	4K	~
100	491	4%	32K	~
500	2,509	21%	0.5M	0.2%
1K	3,807	32%	1.6M	0.4%
2.5K	5,731	47%	4.6M	1.3%
5K	7,388	61%	11M	3%
10K	9,046	74%	23M	7%
15K	9,699	80%	31M	9%
20K	10,073	83%	37M	11%
50K	11,089	91%	69M	20%
100K	11,605	95%	106M	30%
200K	11,872	97%	143M	41%
500K	12,079	99.1%	208M	60%
1M	12,148	99.6%	256M	74%
5M	12,190	99.98%	334M	96%
6.6M	12,192	100%	347M	100%

TABLE D-9. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) SECONDARY ITEM PROVISIONING PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	84	2%	2K	~
100	241	5%	15K	~
500	1,418	30%	0.3M	0.3%
1K	2,028	43%	0.7M	0.6%
2.5K	2,781	59%	2M	1.7%
5K	3,299	69%	4M	3%
10K	3,723	78%	7M	6%
15K	3,897	82%	9M	7%
20K	4,001	84%	11M	9%
50K	4,354	92%	22M	19%
100K	4,527	95%	34M	29%
200K	4,625	97%	48M	41%
500K	4,704	99.1%	74M	63%
1M	4,736	99.8%	96M	82%
4.6M	4,747	100%	116M	100%

TABLE D-10. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) SECONDARY ITEM PRONS,
EXCLUDING PROVISIONING PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	70	1%	2K	~
100	250	3%	17K	~
500	1,091	15%	0.2M	0.1%
1K	1,779	24%	0.8M	0.3%
2.5K	2,950	40%	2.7M	1%
5K	4,089	55%	6.8M	3%
10K	5,323 ^a	71%	16M	7%
15K	5,802	78%	22M	9%
20K	6,072	82%	26M	11%
50K	6,735	90%	47M	20%
100K	7,078	95%	71M	31%
200K	7,247	97%	95M	41%
500K	7,375	99.1%	134M	58%
1M	7,412	99.6%	160M	69%
5M	7,443	99.97%	217M	94%
6.6M	7,445 ^a	100%	231M	100%

^aA total of 7,445 secondary item replenishment PRONS were initiated at HQ, ARRCOM during FY80, of which 5,323 were for PRONS valued less than \$10K each, and 2,122 were for PRONS valued \$10K each or over. These quantities were used throughout this report to help determine the variable costs per PWD.

TABLE D-11. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) PRINCIPAL END ITEM PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	58	2%	1K	~
100	104	4%	5K	~
500	342	12%	76K	~
1K	550	19%	0.2M	~
2.5K	863	30%	0.8M	0.1%
5K	1,153	41%	2M	0.2%
10K	1,441	51%	4M	0.4%
15K	1,591	56%	6M	0.7%
20K	1,692	60%	8M	0.9%
50K	2,025	72%	18M	2%
100K	2,250	79%	35M	4%
200K	2,442	86%	63M	7%
500K	2,627	93%	121M	14%
1M	2,692	95%	167M	19%
5M	2,796	99%	409M	46%
66M	2,831	100%	896M	100%

TABLE D-12. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) AMMUNITION PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	207	4%	5K	~
100	329	6%	14K	~
500	707	13%	0.1M	~
1K	983	19%	0.3M	~
2.5K	1,486	28%	1M	0.1%
5K	1,930	37%	3M	0.2%
10K	2,368	45%	6M	0.4%
15K	2,672	51%	10M	0.7%
20K	2,880	55%	13M	0.9%
50K	3,592	68%	37M	2.6%
100K	4,044	77%	70M	4.8%
200K	4,436	84%	127M	9%
500K	4,839	92%	257M	18%
1M	5,036	95%	399M	27%
5M	5,240	99%	833M	57%
68M	5,284	100%	1,450M	100%

TABLE D-13. FY80 DATA FOR ACTIVE (AS OF 24 NOV 80) O&MA PRONS

<u>\$ AMT/PRON</u>	<u>CUM # OF PRONS</u>	<u>CUM % OF PRONS</u>	<u>CUM \$ AMT</u>	<u>CUM % OF \$ AMT</u>
50	20	3%	~	~
100	24	4%	~	~
500	70	11%	16K	~
1K	103	16%	41K	0.1%
2.5K	176	27%	0.2M	0.2%
5K	245	38%	0.4M	0.6%
10K	336	52%	1.1M	1.7%
15K	385	59%	1.8M	2.6%
20K	413	63%	2.3M	3.3%
50K	492	75%	4.8M	7.1%
100K	544	83%	8.7M	13%
200K	580	89%	14M	21%
500K	624	96%	29M	43%
1M	637	98%	39M	58%
5M	651	99.8%	61M	90%
7M	652	100%	68M	100%

Appendix E

DATA FOR LABOR COSTS

APPENDIX E. DATA FOR LABOR COSTS

This appendix contains the data for labor costs for each of the directorates/offices involved. Shown is the office symbol, name, portion applied, ratio, and function, where:

- a. The portion applied is the percentage of time spent on processing Secondary Item PWDs.
- b. The ratio is an estimate of the amount of time spent on processing one (1) LDV PWD versus the effort expended on processing one (1) HDV PWD. Example: a ratio of 1 to 2 means that twice as much effort is expended in processing high dollar value PWDs as opposed to low dollar value PWDs. A ratio of 0 to 1 means that all effort in a particular area is expended in processing high dollar PWDs.
- c. Function is a brief description of the type of work performed which is applicable to the procurement process.

The above data, specifically the portion applied and the ratio, are used in conjunction with the number of LDV and HDV PWDs processed in order to determine the actual effort expended in the two categories.

APPENDIX E

<u>OFFICE SYMBOL</u>	<u>NAME</u>	<u>PORTION APPLIED</u>	<u>RATIO</u>	<u>FUNCTION</u>
DRSAR-MI	Materiel Management Directorate			
-MHI	Heavy Weapons Division	75%	1 to 1	Item management
-PHI-I	Tank Branch	75%	1 to 3	a. Process SCS w/recommended buys and cutbacks
-PHI-A	Heavy Artillery Branch			
-PHI-L	Light Artillery and Air Defense Branch	75%	1 to 1	
-PLI	Light Weapons Division	75%	1 to 3	b. Answer questions which arise on PMDs
-PMI	Chemical and Nuclear Division			
-PMI-N	Nuclear Branch	35%	1 to 3	c. Alleviate funding problems
-PMI-C	Chemical Branch	55%	1 to 3	d. Process all changes (amendments) to the basic PMDs.
-PIT	Tools and Equipment Division			
-PIT-T	Tools and Test Equipment Branch	60%	1 to 3	e. Followup on procurement status
-PPP	Program, Systems and Evaluation Division			
-PPS-S	Systems Management Branch			
-PPS-SS	Supply Management Systems Section	50%	1 to 1	Assist with problem areas
-PPD	Distribution Division			
-PPD-1	Central Inventory Accounting Branch			
-PPD-IL	Materiel Utilization & Receipts Section	60% of 2 employees	1 to 1	Process DD 250s, receipt of shipment document
-PPD-O	Distribution Management Branch			

APPENDIX E (CONT)

<u>OFFICE SYMBOL</u>	<u>NAME</u>	<u>PORTION APPLIED</u>	<u>RATIO</u>	<u>FUNCTION</u>
DRSAR-MD-DC	Data and Product Control Section	10% of 1 employee	1 to 1	Distribute SCS and PPDs to item managers.
-MD-C	Distribution Management Branch			
-MD-CS	Data Services Section	10% of 1 employee	1 to 1	Key purchasing
DRSAR-CP	Office of the Comptroller			
-CPF	Finance and Accounting Division			
-CPF-F	Working Capital Fund Accounting Branch	100%	1 to 1	Process all ASF PPDs [commit, obligate]
-CPF-C	Procurement/MCA Appropriations Branch	10%	1 to 1	Process all PAS PPDs [commit, obligate]
-CPF-CA	Accounting Section			
DRSAR-H	Administrative Services Branch	10-50% of most employees	1 to 1	Route PPDs, process forms
-LET	Logistics Engineering Directorate			
-LET	Engineering Data Support Division			
-LET-P	Tech Data Branch			
-LET-PR	Large Caliber Section	60% of middle grades, 10% of lower grades. 50-75% of clerical	1 to 1	Assemble TDPs
-LET-PC	Small Caliber Section			
-LET-T	Tech Data Control Branch			
-LET-TR	Tech Data Reproduction Section	60%	1 to 1	Reproduce bid sets

APPENDIX E (CONT)

<u>OFFICE SYMBOL</u>	<u>NAME</u>	<u>POSITION APPLIED</u>	<u>PATIO</u>	<u>FUNCTION</u>
DRSAR-LET-TF	Tech Data Files Section	60%	1 to 1	File, retrieve and maintain RQMs
DRSAR-PC	Procurement Directorate			
-PCS	Primary Support Contract Division			
-PCS-H	Heavy Weapons, Chemical Branch	100%	0 to 1	
-PCS-I	Industrial Support Branch	100%	0 to 1	
-PCS-L	Light Weapon, Tools Equipment Support Branch	100%	0 to 1	Purchase action for all HW Secondary item PBMs
-PCS-M	Intensive Procurement Action Branch	100%	0 to 1	
-PCS-S	Sea II Purchases Branch	100%	1 to 0	Purchase action for all LDV Secondary item PBMs
-PCF	Financial Analysis Cost Estimating Division	122	1 to 1	Support contractual efforts
-PCP	Policy and Management Division			
-PCP-S	Procurement Management Data Branch	10% of Staff	1 to 1	Distribute pros and other documents
-PCP-SP	Procurement Support Section	70%	1 to 1	
-PCP-SD	Data Control Section	70%	1 to 1	Input pros data to computer after awards
-PCP-SW	Word Processing Section	90%	1 to 1	Prepare all contractual instruments and related documents
DRSAR-PD	Production Directorate			

APPENDIX E (CONT)

<u>OFFICE SYMBOL</u>	<u>NAME</u>	<u>PORTION APPLIED</u>	<u>RATIO</u>	<u>FUNCTION</u>
-DRSAR-PDC	Defense Materiel Division Control Branch	30-100% of 4 employees	1 to 1	Make or buy committee action
-DRSAR-M5	Management Information Systems Directorate			
-MSC	Computer Management Division			
-MSC-P	Data Preparation and Quality Control Branch			
-MSC-QQ	Quality Control Section	20% of 2 employees	1 to 1	Separate, staple, and distribute PMs
-DRSAR-QA	Product Assurance Directorate			
-QA6	Weapons Quality Operations Divisions	42%	1 to 1	a. Provide section E of PMs
-QA7	Fire Control & Defense Chemical Equipment Quality Operations Division	25%	1 to 1	b. Provide technical assistance to Procurement and Production If required, provide safety provisions.
-DRSAR-SF	Safety Office	5% of 1 employee	1 to 1	
-DRSAR-SB	Small Business Office	10-70% of 3 employees	1 to 1	Review pre-solicitation documents
-DRSAR-TN	Transportation Directorate			
-TMC	OM/OMC General Traffic Division	30-50% of 2 employees	1 to 1	Determine Government cost of transportation for FOB origin
-TMC-G	General Traffic Branch			
-DRSAR-PP	PPG Policy and Plans Office			

APPENDIX E (CONT)

<u>OFFICE SYMBOL</u>	<u>NAME</u>	<u>PORTION APPLIED</u>	<u>RATIO</u>	<u>FUNCTION</u>
DRSAR-PPR	Review and Compliance Division	~15%	1 to 1	Chair Board of Awards & perform investigative studies
-PPL	Procurement Lead Time Effectiveness Division	65%	1 to 1	Monitor all PMDs
-PPM	Management Systems Division	35%	1 to 1	Resolve problems with items in procurement cycle
DRSAR-GC	Office of Chief Council and Congressional Affairs			
-GCP	Procurement Law Division	6%	0 to 1	Legal review of PMDs valued ≥ \$10K
-GCC	Adversary Proceedings Division	6%	0 to 1	Legal counseling & litigation procedures
-GCS	General Law/Congressional Affairs	3%	0 to 1	
SRAALO	Small Business Administration Liaison Office	10-30%	0 to 1	Screen all PMDs for S-A candidates

Appendix F

DATA FOR ADP COSTS

APPENDIX F. DATA FOR ADP COSTS

This section presents the CCSS applications which totally/partially contribute to the cost to procure. Since these applications are run periodically, the direct labor of computer operators is not included. However, since the length of the run depends on the number of PWDs, the Central Processing Unit (CPU) time is considered part of the Variable Cost to Procure (VCP).

Each paragraph below contains the application number, title, description of application^a, the cost for CPU time for FY79, and the portion applied to the VCP parameters. The cost for CPU time is obtained from the Value Computing Inc. (VCI) FY79 Computer Billing Report. These costs are inflated to FY81 dollars using a composite escalator equal to 1.23^b. The number of secondary item replenishment PWDs initiated in FY79C equaled 9,471 (46% of total PWDs initiated that year), while the total number of PWDs (secondary item, principal end items, and ammunition PWDs) equaled 20,511.

Number 404 - Requirements Control Process

Description: Records requirements to be placed on contract; assures availability of funds; prepares delivery orders for the contracting officer's signature.

Cost of CPU Time: \$26,070 in FY79 (\$32,066 in FY81 dollars)

Applied Percentage: Number Secondary Item PWDs ÷ total number PWDs

Applied Cost: \$32,066 X 46% = \$14,750

Number 405 - CCSS MILSCAP/Interface

Description: Commercial contracts process and procurement due-in processing; generates PWDs.

Cost of CPU Time: \$27,987 in FY79 (\$34,424 in FY81 dollars)

Applied Percentage: Number Secondary Item PWDs ÷ total number PWDs

Applied Cost: \$34,424 X 46% = \$15,835

Number 406 - Financial Fiscal

Description: Processes program and funds for ASF, financial input, accounts receivable, and ASF status of funds.

Cost of CPU Time: \$5,804 in FY79 (\$7,139 in FY81 dollars)

Applied Percentage: 100%

^aReference CCSSOI 18-401, Applications Overview, 16 Oct 79.

^bDF, DRSAR-CP, HQ, ARRCOM, 10 Sep 80, subject: Inflation Guidance, Inc1 7, Operations and Maintenance.

^cMFR, DRSAR-PES, 29 Apr 80, subject: Analysis of PRONS Initiated at HQ, ARRCOM

Number 418 - Pre-Supply Control Study Update

Description: Validates stock number of incoming transactions and accomplishes all NSNMDR updates necessary for SCS process.

Cost of CPU Time: \$10,044 in FY79 (\$12,354 in FY81 dollars)

Applied Percentage: Portion which updates sector 10 of NSNMDR (estimated as 10%)

Applied Cost: \$12,354 X 10% = \$1,235

Number 420 - Supply Control Study (SCS) Review and Computation

Description: Extracts active NSNs from NSNMDR and performs the SCS review and computation; updates the DRD file, feeds data to SCS application.

Cost of CPU Time: \$10,606 in FY79 (\$13,045 in FY81 dollars)

Applied Percentage: Portion which leads to recommended buys or cutbacks in Application #532 (14.7%; refer to Table F-1)

Applied Cost: \$13,045 X 14.7% = \$1,918

Number 421 - Supply Control Study (SCS) Format and Print

Description: Formats and prints SCS and PWDs

Cost of CPU Time: \$8,443 in FY79 (\$10,385 in FY81 dollars)

Applied Percentage: 100%

Number 471 - Standard Automated Bidders List (SABL)

Description: Produces the SABL, adhesive mailing labels, and/or management reports upon request from the procurement contracting officers.

Cost of CPU Time: \$16,507 in FY79 (\$20,304 in FY81 dollars)

Applied Percentage: Number Secondary Item PWDs : total number PWDs

Applied Cost: \$20,304 X 46% = \$9,340

Number 511 - Procurement Aging and Staging System (PASS)

Description: Tracks PWDs

Cost of CPU Time: \$1,283 in FY79 (\$1,578 in FY81 dollars)

Applied Percentage: 100%

Number 518 - Work Ordering and Reporting Communications System (WORCS)

Description: Provides a method of recording WORCS obligation and PWD performance data in the MAD file; establishes contractual dues-in from procurement and provides data for lead time and pricing information in the NSNMDR.

Cost of CPU Time: \$2,208 in FY79 (\$2,716 in FY81 dollars)

Applied Percentage: Number Secondary Item PWDs : total number PWDs

Applied Cost: \$2,716 X 46% = \$1,249

Number 521 - Contract Input Data Entry System (COIN)

Description: Accepts contract data; output of this goes to

Application #405, CCSS MILSCAP/Interface.

Cost of CPU Time: Unknown

Applied Percentage: 100%

Number 532 - Requirements Determination and Execution System

Description: Supply control simulator; develops SCS

Cost of CPU Time: \$11,073 in FY79 (\$13,620 in FY81 dollars)

Applied Percentage: Number SCS with recommended buys and cutbacks ÷
total number SCS. (70.5%; refer to Table F-1)

Applied Cost: \$13,620 X 70.5% = \$9,602

Number 542 - Army Remote Terminal Inquiry System (ARTIS)

Description: Used to research problems, etc.; also used to enter
procurement input data via DIVIT for manually processed PRONs.

Cost of CPU Time: Unknown

Applied Percentage: Time for DIVIT + total time

Number 558 - EOQ/VSL Simulation

Description: Management tool for item managers; used to show impacts
of changes parameters to recommended buy quantities.

Cost of CPU Time: Unknown and considered negligible

TABLE F-1. APPLIED PERCENTAGES FOR APPLICATION #532 AND #420

APPLICATION #532 ^a						APPLICATION #420 ^b					
RECOMMENDED BUYS ^c			CUTBACKS ^c			TOTAL SCS			NUMBER OF ITEMS ACTIVATED		
HDV	LDW	TOTAL	HDV	LDW	< \$K	HDV	LDW	> \$5K	HDV	LDW	TOTAL
> \$5K	< \$5K	Total	> \$5K	< \$5K	Total	> \$5K	< \$5K	Total	> \$5K	< \$5K	Total
807	1,348	2,156	314	543	1,357	6,385	5,337	18,487	23,824	80208	
711	2,125	2,836	745	742	1,487	4,809	3,976	24,824	28,800	80136	
671	1,778	2,449	901	1,216	2,117	5,345	5,286	26,500	31,786	80086	
806	1,648	2,454	661	1,323	1,984	4,814	3,577	17,190	20,767	80056	
820	1,328	2,148	579	1,023	1,602	8,617	5,353	20,221	25,574	79348	
600	1,150	1,750	713	1,403	2,116	4,738	4,298	31,565	35,863	79312	
4,415	637	5,052	4,413	411	595	10,663	10,663	34,708	166,614		
TOTALS:	13,793										

^aThe percentage of applicable costs for Application #532 is equal to the sum of recommended buys plus cutbacks, divided by the total number of SCS: $(13,793 + 10,663) / 34,708 * 100.0\% = 70.5\%$

^bThe percentage of applicable costs for Application #420 is equal to the sum of recommended buys plus cutbacks from Application #532, divided by the total number of items activated: $(13,793 + 10,663) / 166,614 * 100.0\% = 14.7\%$.

^cThe number of recommended buys and cutbacks were extracted for the following analyst codes: NJ2XX, NJ3XX, NJ4XX, NW2XX, NW3XX, NW4XX, NL2XX, NL3XX, where the 4th and 5th positions could be any combination of numbers or letters.

Appendix G

DATA FOR SUPPORT COSTS

APPENDIX G. DATA FOR SUPPORT COSTS

This appendix contains the background information on support costs and how portions are applied to the VCP parameters. Basically, the total budget in a given office is obtained, say for materials and supplies, and then the equivalent number of personnel in that office which process Secondary Item PWDs is determined (i.e., if two employees each process PWDs 50% of their time, together they are equal to one equivalent personnel). Then the office supplies are prorated according to the number of equivalent personnel processing PWDs versus total number of personnel in that office. The equivalent number of personnel is one of the outputs of the computer program documented in Appendix C.

1. Materials and Supplies

Procurement Directorate: Total budget \$51K for FY79 (\$62.73K in FY81 dollars).

Based on number of personnel processing LDV and HDV Secondary Item PWDs versus total number in the Procurement Directorate, applicable costs are:

	<u>\$/PWD</u>	<u># PWDs</u>	<u>Annual Cost</u>
for LDV PWDs	1.38	5,323	\$ 7,346
for HDV PWDs	4.79	2,122	\$10,164

Logistics Engineering Directorate: Total budget of \$272K for FY79 of which 67% or \$182K is in support of processing all PWDs, including Secondary items, principal items, and ammunition. The percent applied to Secondary Item PWDs is found as follows:

An average of 10 aperture cards per Secondary Item TDP times an average of 20 bid sets required per TDP times total number of Secondary Item Replenishment PWDs (9,471 in FY79) divided by 9M IBM cards consumed in FY79 equals 21%.

Therefore, $21\% \times \$182K = \$38K$ in FY79 dollars (\$47K in FY81 dollars) is spent in support of Secondary Item PWDs, which is prorated as follows:

$$\text{cost}/\text{PWD} = \$47K/9,471 = \$4.96/\text{PWD}$$

	<u>\$/PWD</u>	<u># PWDs</u>	<u>Annual Cost</u>
for LDV PWDs	4.96	5,323	\$26,402
for HDV PWDs	4.96	2,122	\$10,525

^aData obtained from the Materiel Acquisition and Delivery Issued (MADISS) File, Sector 00, Segment 201.

2. Long Distance Telephone Calls:

Procurement Directorate, in the division processing Secondary Item PWDs, had a telephone bill totalling \$973 in FY79 (\$1,197 in FY81 dollars) for commercial long distance calls, prorated as follows:

	<u>\$/PWD</u>	<u>#PWDs</u>	<u>Annual Cost</u>
for LDV PWDs	0.16	5,323	\$ 856
for HDV PWDs	0.16	2,122	\$ 341

3. Mail:

Per phone call with the chief in DRSAR-PCP-S, it was found that there were 89,368 packages mailed in a year from the Procurement Directorate, at an estimated cost of between \$1.75 to \$2.00 per package. From this the following is determined:

- a) Total cost for mail service = 89,368 mailings/yr X \$1.875/mailings = \$167,565/yr
- b) Since the total number of PWDs initiated in FY80 = 20,959 (see appendix D, pg D-4); cost per PWD = \$167,565/yr ÷ 20,959 PWDs/yr = \$7.99/PWD
- c) Cost for replenishment actions is then:

	<u>\$/PWD</u>	<u>#PWDs</u>	<u>Annual Cost</u>
for LDV PWDs	7.99	5,323	\$42,531
for HDV PWDs	7.99	2,122	\$16,955

4. Personnel Support: As per guidance of AR 710-1, a percent of the Civilian Personnel Office (CPO) was included in the VCP parameter. This percent, determined by dividing the equivalent number of personnel processing Secondary Item PWDs by the total number of personnel supported by the CPO, was found to equal 4%. The total applicable cost for a year is \$87,701, which is divided as follows:

	<u>\$/PWD</u>	<u>#PWDs</u>	<u>Annual Cost</u>
for LDV PWDs	8.37	5,323	\$44,535
for HDV PWDs	20.34	2,122	\$43,166

5. Equipment Rental: Most equipment rental is in the Logistics Engineering Directorate where it's used in reproducing bid sets. It was determined that even if the secondary item workload was reduced by 50%, the same amount of equipment would be required to support the principal items, ammunition items, and the reduced secondary item workloads. The other significant equipment rental is in the word processing area of the Procurement Directorate. However, the same argument as above holds true and this cost was not included.

DISTRIBUTION

NO. OF COPIES

Commander, US Army Materiel Development & Readiness Command, 5001
Eisenhower Ave., Alexandria, VA 22333

1 DRCMM-R
2 DRCMM-RS
1 DRCPA-S
1 DRCCP-E

Commander, US Army Missile Command, Huntsville, AL 35809

1 DRSMI-S
1 DRSMI-DC
1 DRSMI-FC

Commander, US Army Armament Materiel Readiness Command, Rock Island,
IL 61299

1 DRSAR-MM
1 DRSAR-CPE-D
5 DRSAR-MMP-SS
5 DRSAR-PE

Commander, US Army Communications & Electronics Materiel Readiness
Command, Fort Monmouth, NJ 07703

1 DRSEL-MM
1 DRSEL-PL-SA

Commander, US Army Troop Support & Aviation Materiel Readiness
Command, 4300 Goodfellow Blvd., St. Louis, MO 63120

1 DRSTS-S
2 DRSTS-CCC

Commander, US Army Tank Automotive Command, Warren, MI 48090

1 DRSTA-F
2 DRSTA-VC(W)
1 DRSTA-SA

DISTRIBUTION (Cont)

NO. OF COPIES

- 1 Commandant, US Army Logistics Management Center, Fort Lee, VA 23801
- 10 Defense Technical Information Center, Cameron Station, Alexandria, VA 22314
- 1 Defense Logistics Agency, DLA-LO, Cameron Station Alexandria, VA 22314
- 1 Logistics Studies Office, DRXMC-LSO, ALMC, Fort Lee, VA 23801
- 2 US Army Inventory Research Office, Room 800, US Custom House, 2nd & Chestnut Street, Philadelphia, PA 19106